

VISTAS Meteorological Modeling Results of Annual Simulation

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Acknowledgement

◆ All Excel plots created by NCDAQ and used with their permission (courtesy Mike Abraczinskas and Nick Witcraft

Introduction

- ◆ MM5 options based on sensitivity results
- ◆ Minor differences from px_acm8 run:
 - MM5v3.6.2 preprocessors
 - ◆ MM5 itself still v3.6.1+ (Sea ice diffs)
 - RADFRQ decreased to 15 min
 - Change to LITTLE_R input files
 - ◆ Upper air data included in "surface obs"
 - Climatological albedo (recommended for NOAH LSM) not included in REGRID output
 - ◆ Default regridder options

Introduction (continued)

- ◆ MM5 executed in 5.5 day segments
- ◆ 76 total segments
- ◆ 00Z Dec 17, 2001 start
 - dec17_01 date tag
- ◆ 12Z Jan 1, 2003 finish
 - Last hour of dec27_02 segment

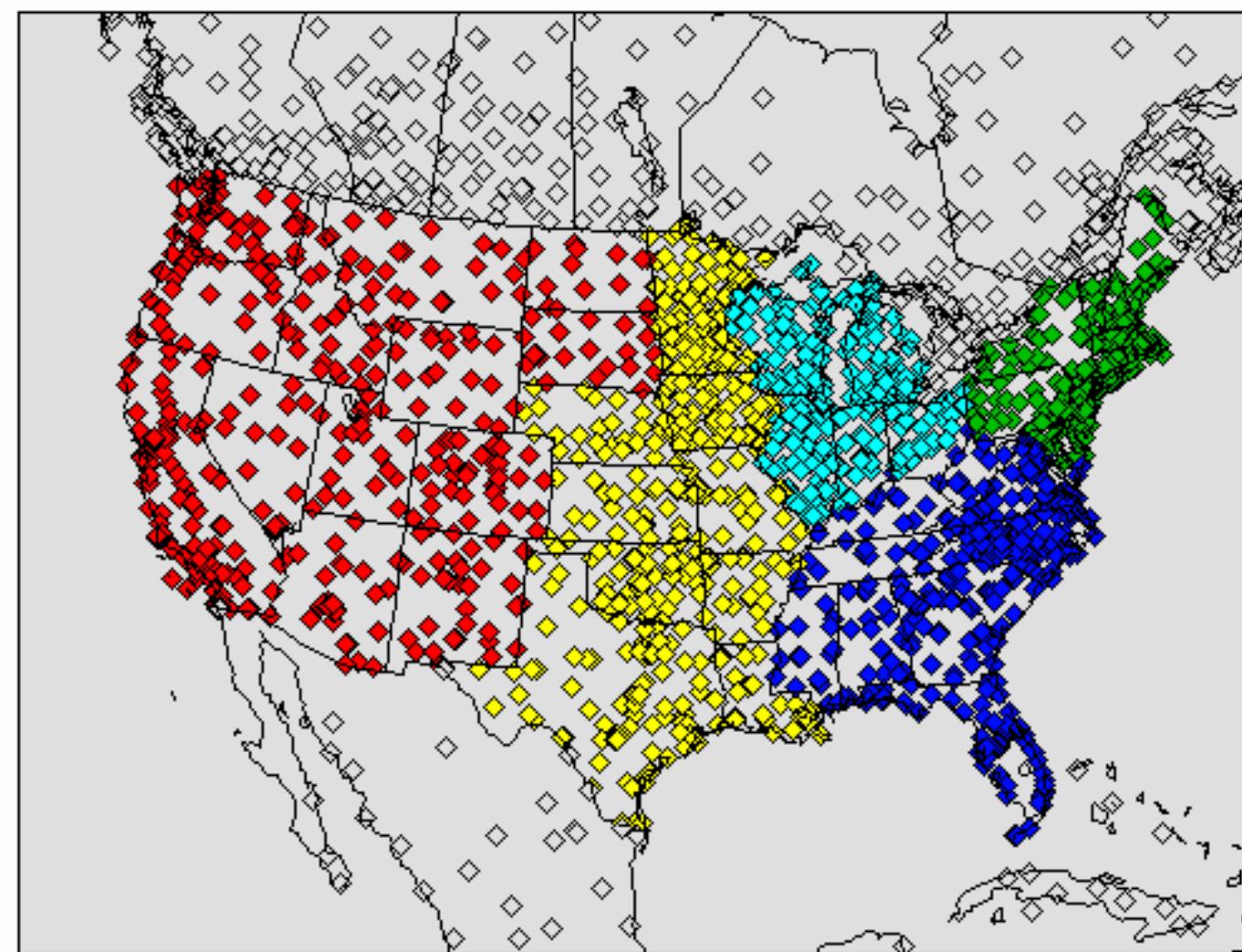
Evaluation Procedures

- ◆ Full suite of evaluation products available for each segment
 - Surface Products
 - ◆ Spatial
 - ◆ Timeseries
 - ◆ Combination
 - Aloft Products
 - ◆ Spatial
 - ◆ Sounding
 - ◆ Profiler
 - Statistical Products
 - ◆ Surface timeseries
 - ◆ Aloft timeseries
 - ◆ Tables

Evaluation Sites by RPO

(VISTAS: Dk blue; MANE-VU: Green; MIDWEST: Lt blue; CENRAP: Yellow; WRAP: Red)

112



1

1

148

Evaluation Products (Continued)

- ◆ [http://www.baronams.com/projects/
VISTAS/select_annual_product.html](http://www.baronams.com/projects/VISTAS/select_annual_product.html)
- ◆ Need to Summarize Results
- ◆ Monthly Products
 - Statistical Tables
 - Spatial Summary Plots
 - “Bakergrams” (annual)
 - “Bakergrams” (monthly)
 - Spatial Statistical Plots
 - Accumulated Precip Plots

Statistical Definitions

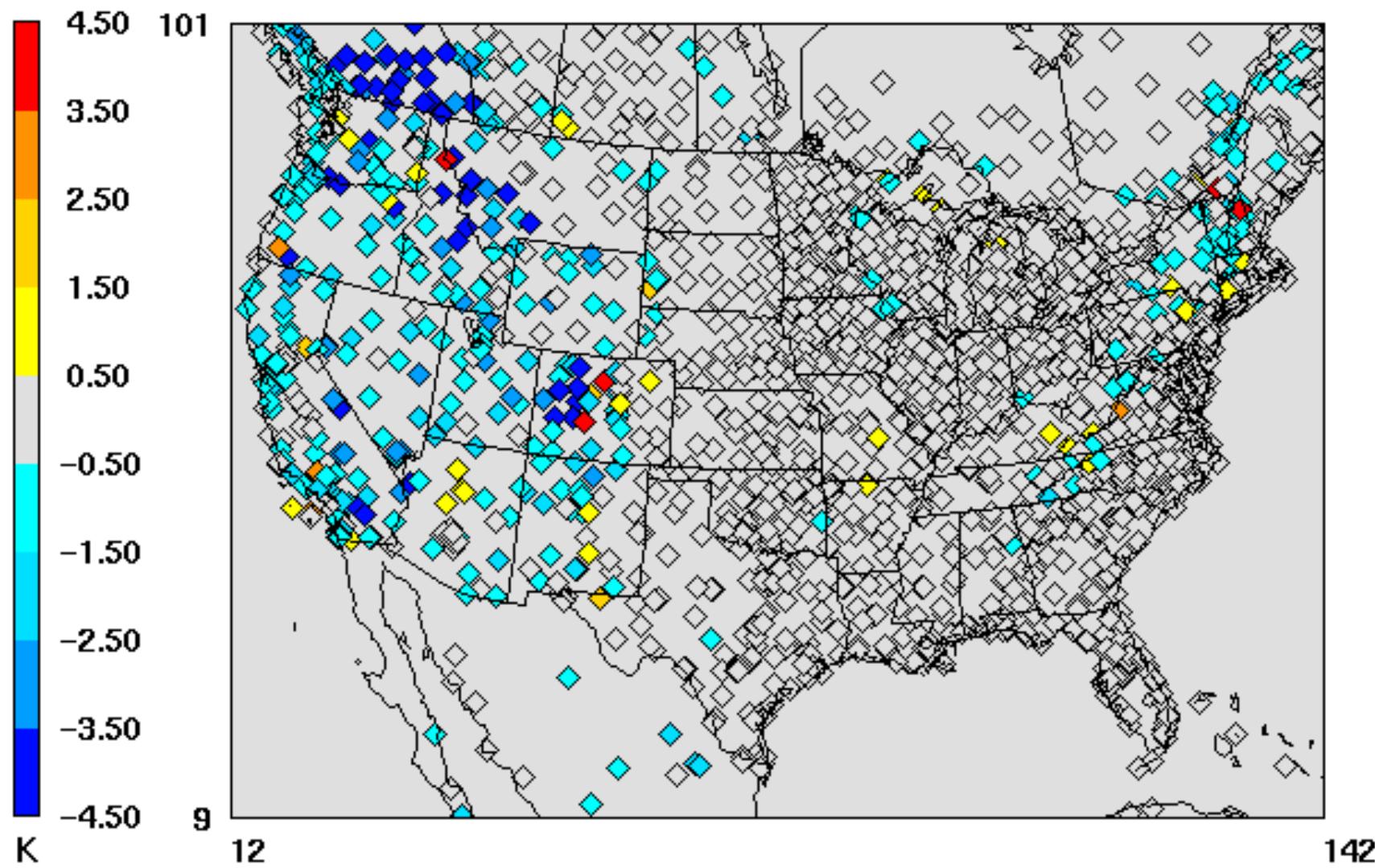
- ◆ Variable names usually self-explanatory
 - 3 wind speed variables
 - ◆ WSPD_regular (calm obs = 0.0 kts)
 - ◆ WSPD_calm (calm obs thrown out)
 - ◆ WSPD_mincalm (calm obs = 1.5 kts)
 - 2 cloud variables
 - ◆ CLD (MCIP2.1 output var CFRAC)
 - ◆ CLD2 (Max cfracl, cfracm, cfrach)
- ◆ Wind Dir stats are unique
 - Use dbias (not bias) for true wdir bias

A note on temperature

- ◆ Like all non-precip variables, based on bilinear interpolation to obs site
- ◆ Additionally, a vertical “interpolation” is applied
 - Obs sites that have an elevation difference > 500 m from MM5 terrain is thrown out (non-representative)
 - A standard atmosphere lapse rate (6.5 C/km) is applied to account for these elevation “errors”
 - ◆ Not a perfect solution
 - ◆ Better than no adjustment
 - ◆ Significant effect in the west

TDIFF

(Stnd atm temp diff based on model/obs elev ht diff)



January 2002 Stat Table (12-km, Full)

Total_stats	obsmean	modmean	bias	abserr	r2	ia	rmse	nbias	jtot
TMP-1.5m_(K)	277.89	276.87	-1.03	2.05	0.910	0.973	2.70059	0.00364	480126
QV_(g/kg)	4.46	4.63	0.17	0.58	0.936	0.983	0.83009	-0.06401	472271
RH_(%)	72.10	77.66	5.56	12.25	0.470	0.812	15.92663	-0.11393	472217
WSPD-regular_(m/s)	3.51	3.76	0.25	1.31	0.496	0.808	1.67567	-99.00000	466042
WSPD-nocalms_(m/s)	4.14	4.04	-0.10	1.14	0.444	0.805	1.50113	-0.08546	395406
WSPD-mincalm_(m/s)	3.63	3.76	0.13	1.19	0.502	0.823	1.54222	-0.35402	466042
SPD-lyr1_(m/s)	3.63	4.47	0.84	1.43	0.485	0.793	1.80626	-0.64790	466042
CLD_(%)	43.14	37.00	-6.14	24.52	0.414	0.792	35.41226	-99.00000	466016
CLD2_(%)	43.14	40.98	-2.15	23.30	0.411	0.805	35.95408	-99.00000	466016
TMP-lyr1_(K)	277.89	277.39	-0.50	1.97	0.906	0.974	2.58621	0.00173	480126

Wdir_stats	obsmean	modmean	bias	abserr	ubias	vbias	uerr	verr	newtot	dbias
WDIR_(deg)	255.83	254.29	-1.54	19.51	0.039	0.048	1.14482	1.21661	466042	1.667

Pcp_threshold(in)	ACC	BIAS	THREAT	ETS	FAR	HK	HSS	POD	HITS	ZEROES	MISSES	FALSES
0.01	0.8665	1.0776	0.6672	0.5387	0.2285	0.7145	0.7002	0.8314	151526	338883	30719	44870
0.05	0.9187	1.0396	0.6962	0.6238	0.1948	0.7792	0.7684	0.8371	105380	414627	20501	25490
0.10	0.9342	1.0168	0.6881	0.6330	0.1915	0.7804	0.7753	0.8221	82119	446660	17770	19449
0.25	0.9555	0.9315	0.6602	0.6266	0.1754	0.7474	0.7705	0.7681	48901	491933	14764	10400
0.50	0.9665	0.9319	0.5626	0.5412	0.2536	0.6800	0.7023	0.6956	24395	522640	10676	8287
1.00	0.9851	0.8378	0.4887	0.4804	0.2799	0.5976	0.6490	0.6033	8042	549542	5288	3126

April 2002 Stat Table (12-km, Full)

Total_stats	obsmean	modmean	bias	abserr	r2	ia	rmse	nbias	jtot
TMP-1.5m_(K)	288.08	287.89	-0.19	1.57	0.943	0.984	2.03842	0.00058	471754
QV_(g/kg)	8.06	8.04	-0.02	1.01	0.901	0.973	1.37537	0.00944	464645
RH_(%)	68.59	69.02	0.43	11.03	0.600	0.877	14.54039	-0.02005	464619
WSPD-regular_(m/s)	3.87	4.05	0.18	1.31	0.567	0.849	1.68699	-99.00000	452937
WSPD-nocalms_(m/s)	4.44	4.33	-0.11	1.18	0.532	0.847	1.55713	-0.07088	394419
WSPD-mincalm_(m/s)	3.97	4.05	0.08	1.22	0.576	0.859	1.57709	-0.29562	452937
SPD-lyr1_(m/s)	3.97	4.75	0.78	1.44	0.560	0.835	1.81917	-0.55694	452937
CLD_(%)	42.90	39.07	-3.84	25.35	0.361	0.775	35.39671	-99.00000	461606
CLD2_(%)	42.90	43.78	0.87	24.80	0.356	0.782	36.59769	-99.00000	461606
TMP-lyr1_(K)	288.08	287.84	-0.23	1.70	0.934	0.982	2.18773	0.00072	471754

Wdir_stats	obsmean	modmean	bias	abserr	ubias	vbias	uerr	verr	newtot	dbias
WDIR_(deg)	209.00	193.43	-15.57	21.59	-0.136	0.128	1.21178	1.32356	452937	1.209

Pcp threshold(in)	ACC	BIAS	THREAT	EIS	FAR	HK	HSS	POD	HITS	ZEROES	MISSES	FALSES
0.01	0.8076	1.0262	0.6342	0.4363	0.2338	0.6096	0.6075	0.7863	182679	259687	49644	55730
0.05	0.8354	1.1194	0.5856	0.4483	0.3007	0.6404	0.6190	0.7828	127452	330107	35373	54808
0.10	0.8506	1.1779	0.5467	0.4363	0.3464	0.6450	0.6075	0.7698	98728	367153	29523	52336
0.25	0.8798	1.2975	0.4620	0.3905	0.4404	0.6314	0.5617	0.7261	56542	425366	21331	44501
0.50	0.9218	1.4147	0.3914	0.3524	0.5198	0.6205	0.5211	0.6793	27536	477396	12999	29809
1.00	0.9662	1.3585	0.2433	0.2303	0.6603	0.4399	0.3744	0.4615	5950	523284	6942	11564

July 2002 Stat Table (12-km, Full)

Total_stats	obsmean	modmean	bias	abserr	r2	ia	rmse	nbias	jtot
TMP-1.5m_(K)	298.81	298.76	-0.06	1.45	0.845	0.952	1.87971	0.00014	487170
QV_(g/kg)	15.27	15.10	-0.17	1.57	0.665	0.901	2.05339	0.00492	478167
RH_(%)	73.17	72.91	-0.26	9.27	0.582	0.872	12.17288	-0.01525	478139
WSPD-regular_(m/s)	2.54	2.93	0.38	1.28	0.376	0.753	1.62831	-99.00000	456961
WSPD-nocalms_(m/s)	3.35	3.23	-0.11	1.07	0.330	0.756	1.42205	-0.06657	347258
WSPD-mincalm_(m/s)	2.73	2.93	0.20	1.11	0.389	0.779	1.43773	-0.41674	456961
SPD-lyr1_(m/s)	2.73	3.50	0.77	1.35	0.369	0.742	1.69625	-0.73414	456961
CLD_(%)	26.37	31.74	5.37	27.26	0.134	0.625	35.75912	-99.00000	473107
CLD2_(%)	26.37	37.08	10.71	29.06	0.139	0.633	38.65865	-99.00000	473107
TMP-lyr1_(K)	298.81	298.75	-0.06	1.73	0.797	0.928	2.19164	0.00012	487170

Wdir_stats	obsmean	modmean	bias	abserr	ubias	vbias	uerr	verr	newtot	dbias
WDIR_(deg)	222.63	203.14	-19.49	31.93	0.000	0.358	1.21420	1.32984	456961	1.568

Pcp_threshold(in)	ACC	BIAS	THREAT	EIS	FAR	HK	HSS	POD	HITS	ZEROES	MISSES	FALSES
0.01	0.7420	0.9319	0.6036	0.3189	0.2197	0.4865	0.4836	0.7272	222407	197539	83444	62608
0.05	0.7300	1.0806	0.5090	0.2857	0.3505	0.4505	0.4445	0.7018	158414	254768	67312	85504
0.10	0.7307	1.1879	0.4407	0.2562	0.4366	0.4285	0.4079	0.6692	120096	293476	59356	93070
0.25	0.7569	1.4958	0.3029	0.1874	0.6121	0.3764	0.3156	0.5802	59791	368606	43254	94347
0.50	0.8266	2.0711	0.1711	0.1154	0.7834	0.3080	0.2069	0.4487	20260	447587	24894	73257
1.00	0.9318	3.4324	0.0636	0.0500	0.9227	0.2088	0.0952	0.2652	2623	524776	7269	31330

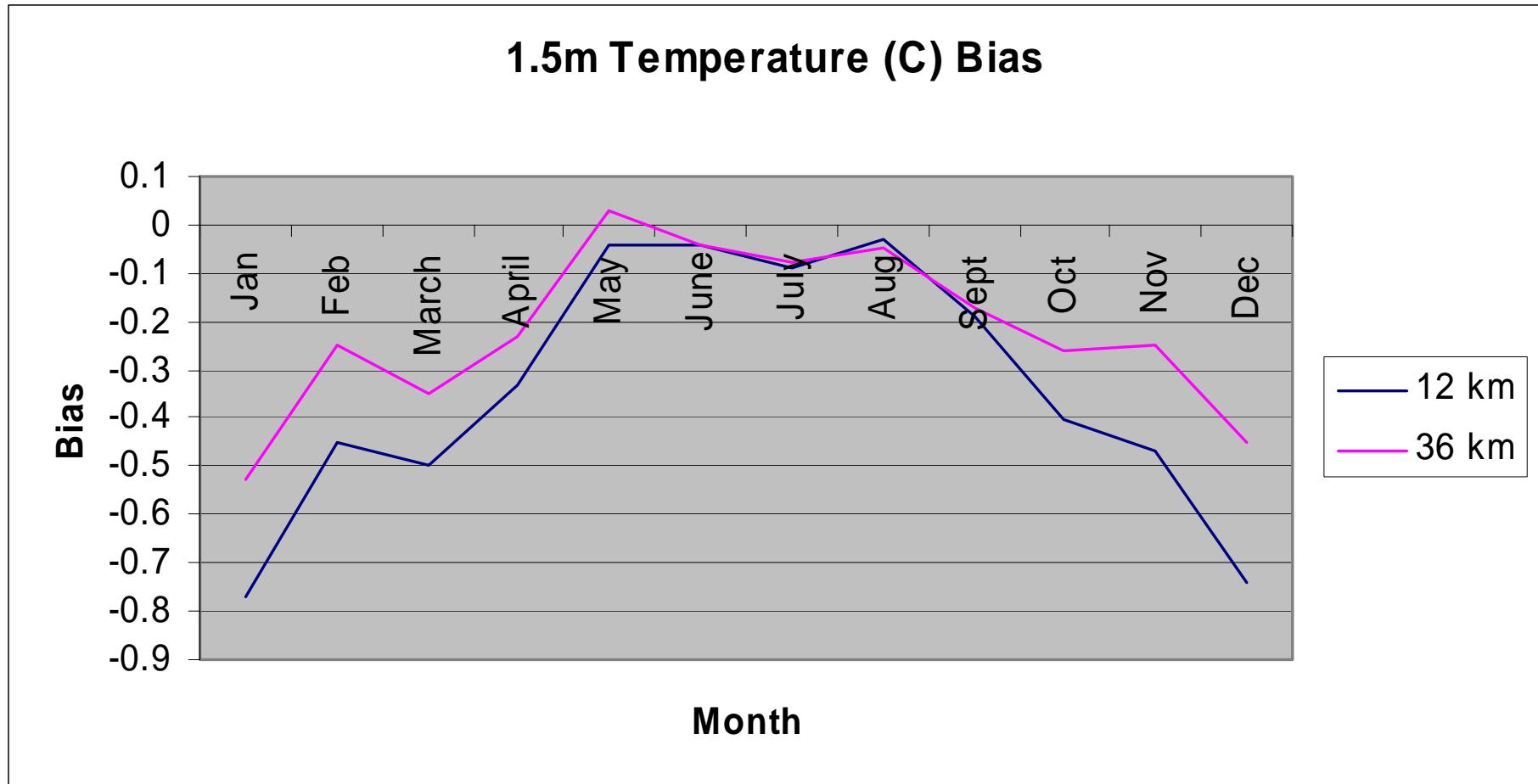
October 2002 Stat Table (12-km, Full)

Total_stats	obsmean	modmean	bias	abserr	r2	ia	rmse	nbias	jtot
TMP-1.5m_(K)	287.55	287.06	-0.48	1.43	0.949	0.986	1.82413	0.00165	494315
QV_(g/kg)	9.05	8.61	-0.43	0.96	0.930	0.980	1.30642	0.05585	485751
RH_(%)	79.12	76.52	-2.60	10.56	0.488	0.827	14.51381	0.02483	485734
WSPD-regular_(m/s)	2.84	3.28	0.44	1.27	0.485	0.803	1.61567	-99.00000	473203
WSPD-nocalms_(m/s)	3.61	3.61	0.00	1.06	0.448	0.813	1.40056	-0.10252	372607
WSPD-mincalm_(m/s)	3.01	3.28	0.28	1.12	0.500	0.826	1.43520	-0.43255	473203
SPD-lyr1_(m/s)	3.01	3.89	0.88	1.38	0.475	0.785	1.73316	-0.74139	473203
CLD_(%)	53.80	49.66	-4.14	24.97	0.420	0.798	34.21059	-99.00000	477460
CLD2_(%)	53.80	56.68	2.88	22.91	0.420	0.810	35.15409	-99.00000	477460
TMP-lyr1_(K)	287.55	287.27	-0.28	1.60	0.932	0.982	2.05254	0.00092	494315

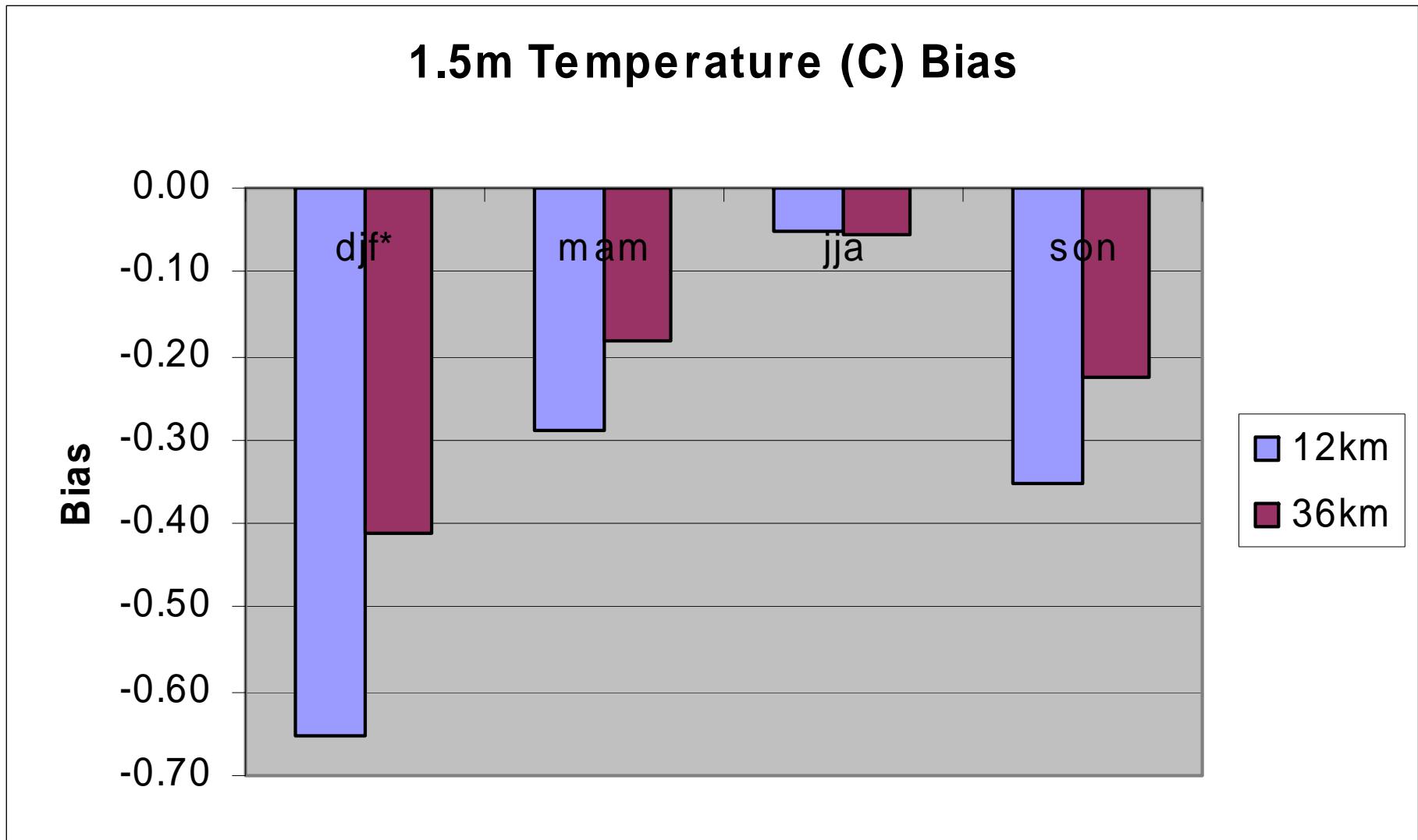
Wdir_stats	obsmean	modmean	bias	abserr	ubias	vbias	uerr	verr	newtot	dbias
WDIR_(deg)	16.35	26.54	10.19	24.40	-0.144	-0.030	1.12207	1.21988	473203	2.365

Pcp_threshold(in)	ACC	BIAS	THREAT	ETS	FAR	HK	HSS	POD	HITS	ZEROES	MISSES	FALSE
0.01	0.8026	0.8851	0.6429	0.4317	0.1666	0.6007	0.6031	0.7377	201122	253161	71522	40193
0.05	0.8360	0.8813	0.5965	0.4563	0.2024	0.6090	0.6266	0.7029	137196	336001	57989	34812
0.10	0.8504	0.8643	0.5488	0.4375	0.2357	0.5831	0.6087	0.6606	102992	378320	52918	31768
0.25	0.8760	0.7899	0.4406	0.3690	0.3070	0.4948	0.5391	0.5474	55292	440507	45708	24491
0.50	0.9110	0.6908	0.3192	0.2796	0.4078	0.3771	0.4370	0.4091	23629	491971	34127	16271
1.00	0.9607	0.6572	0.1878	0.1743	0.6013	0.2479	0.2969	0.2621	5149	538586	14499	7764

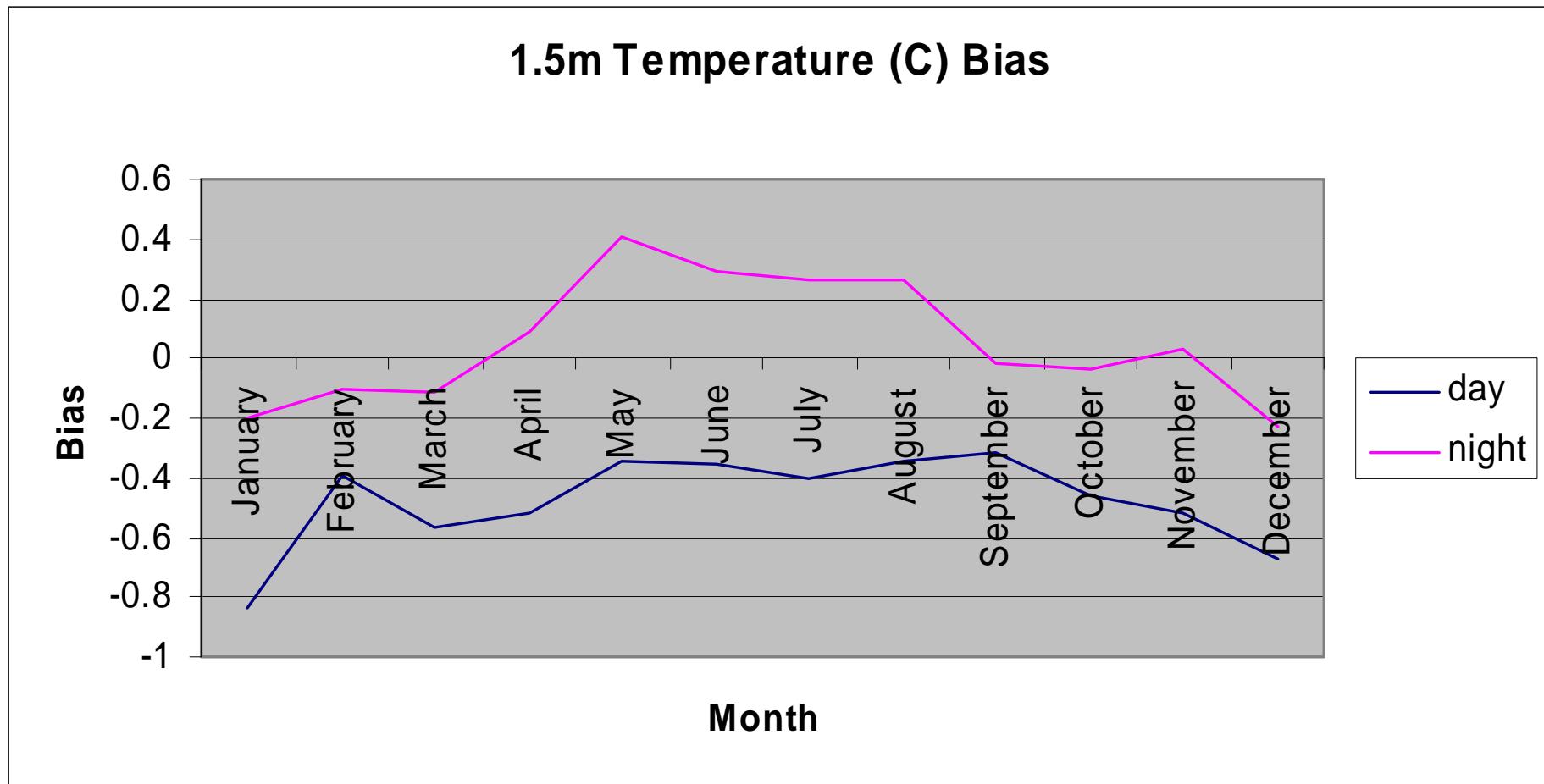
Monthly VISTAS Stats (T)



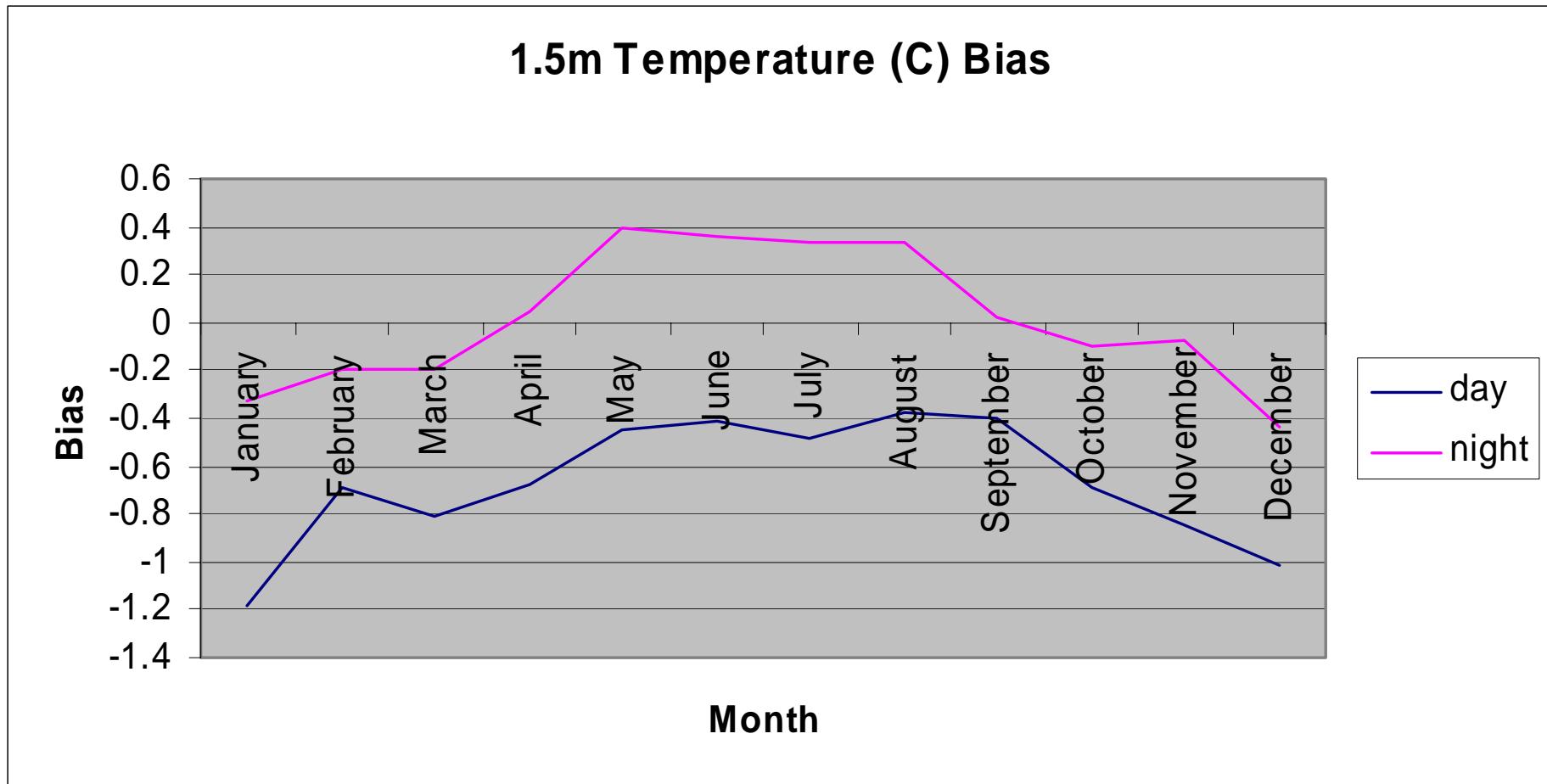
Seasonal VISTAS Stats (T)



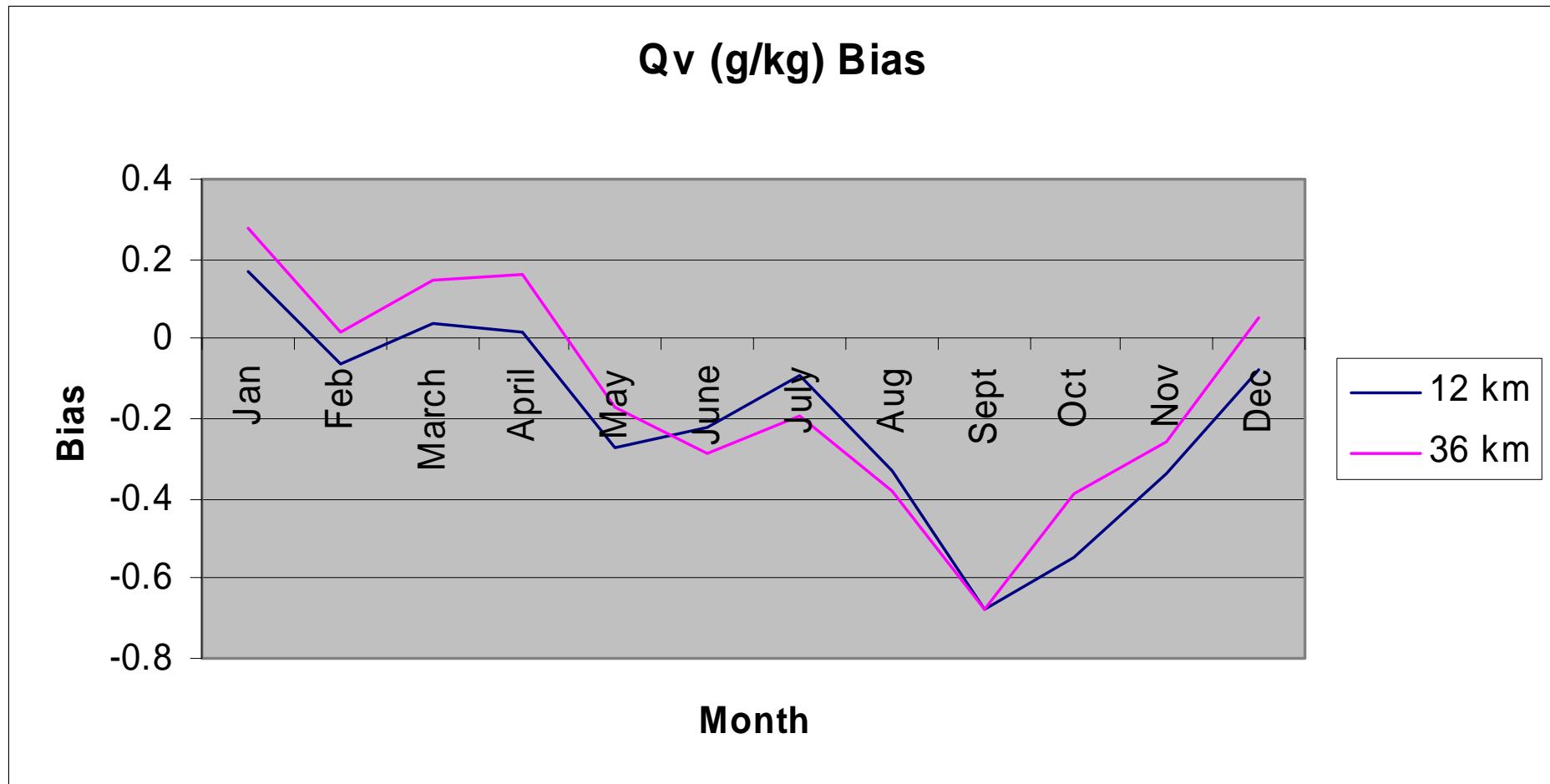
Day/night VISTAS stats, 36km



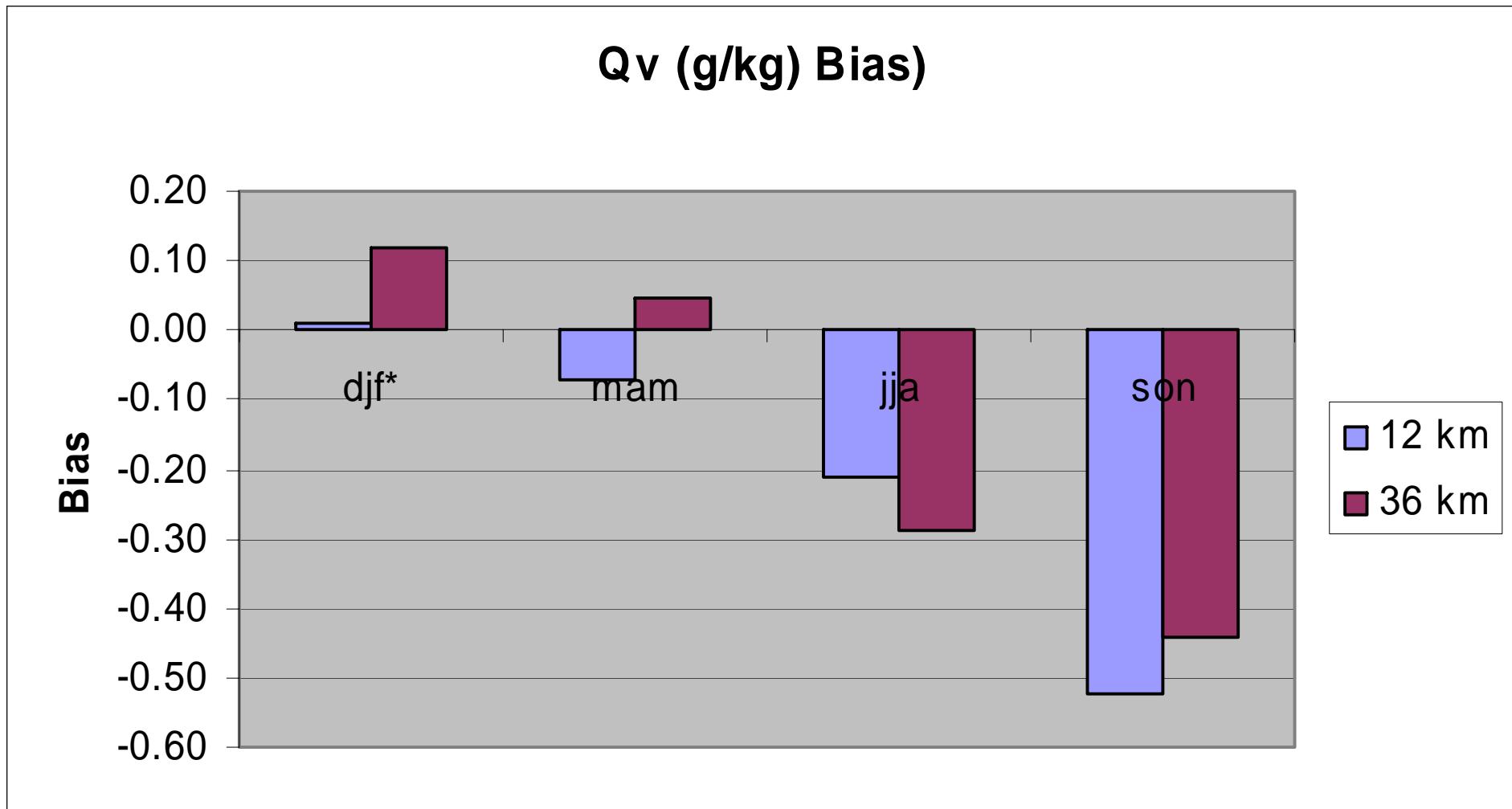
Day/night VISTAS stats, 12km



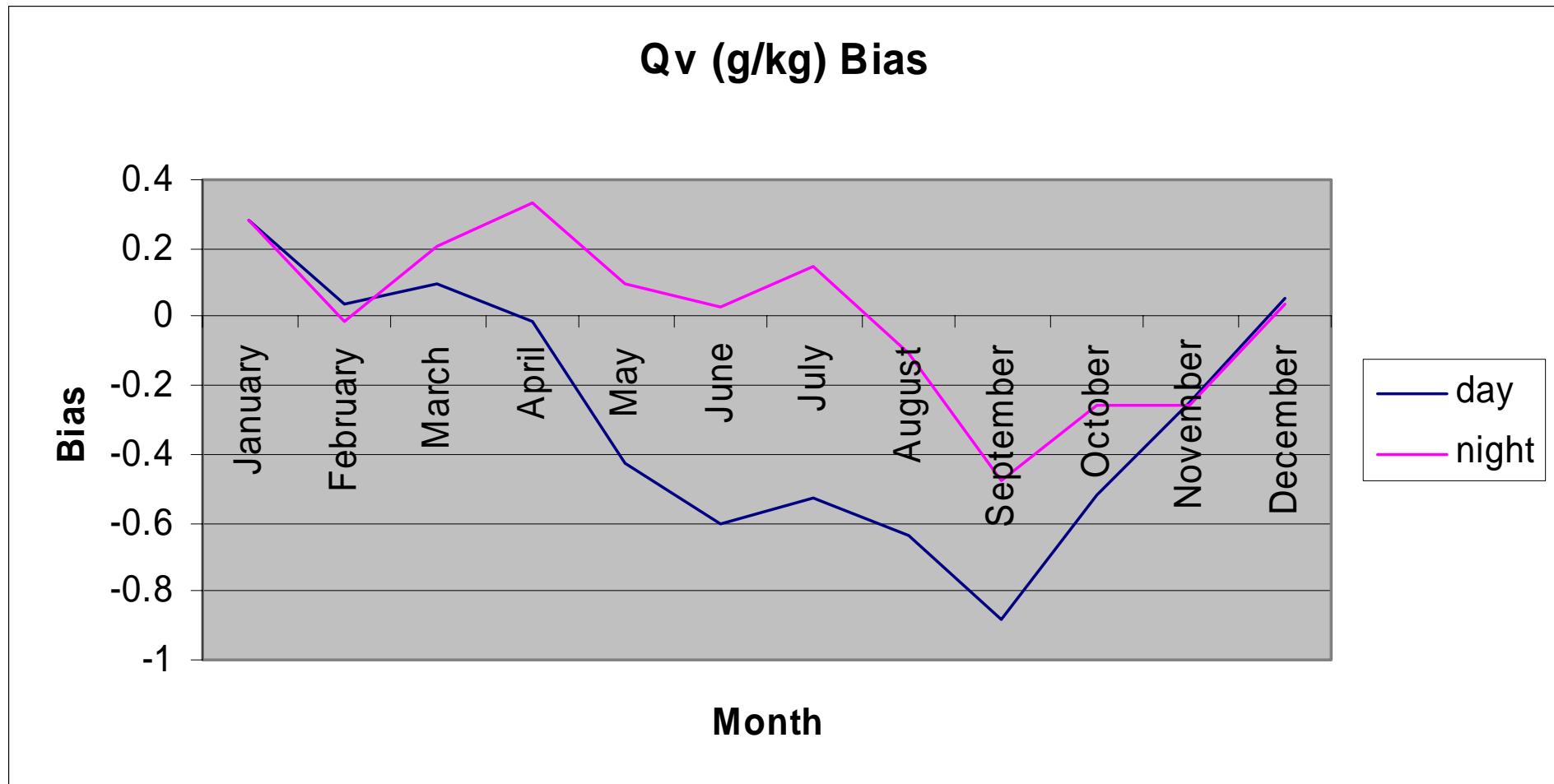
Monthly VISTAS stats



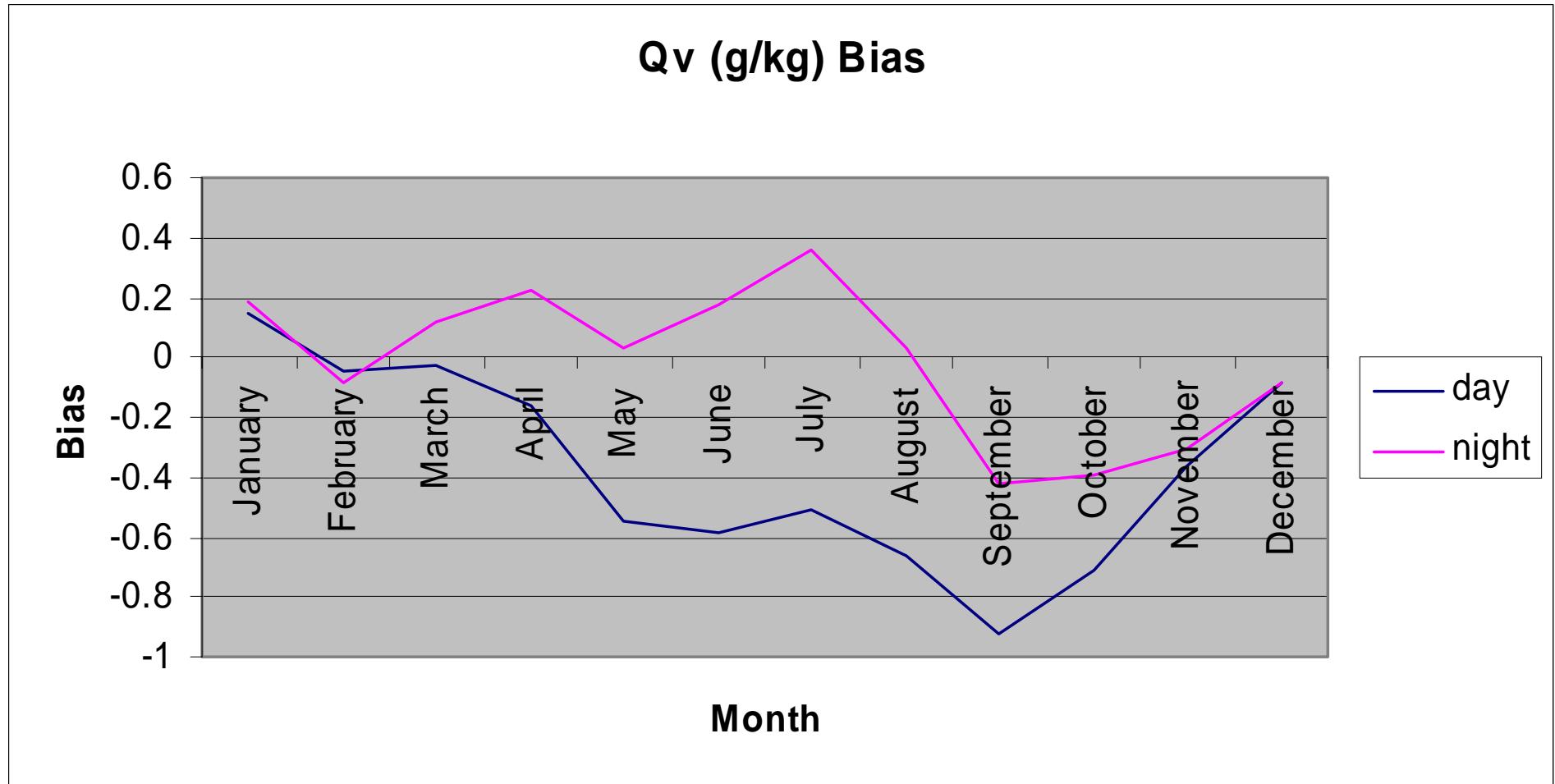
Seasonal VISTAS stats



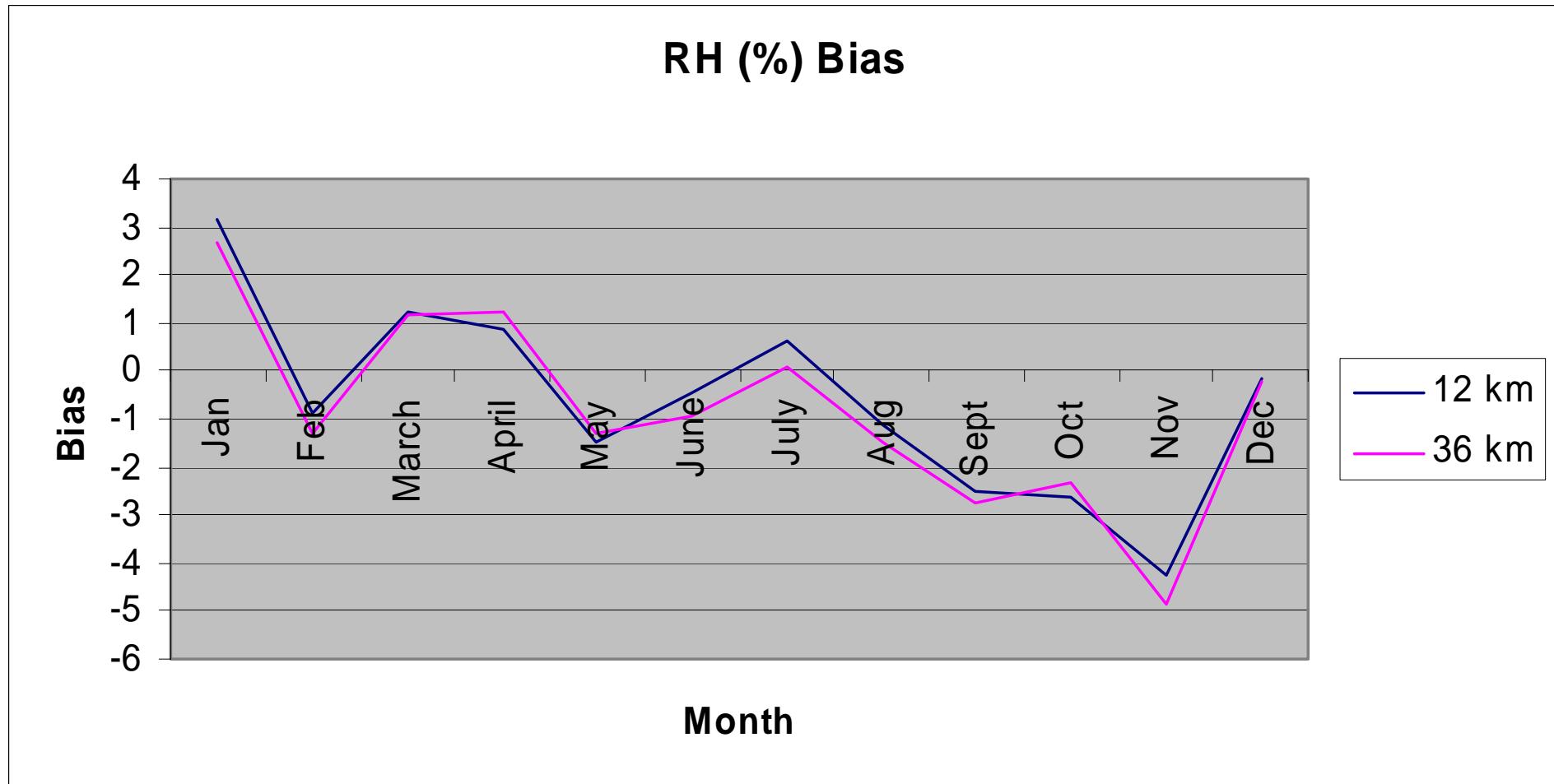
Day/night VISTAS stats, 36km



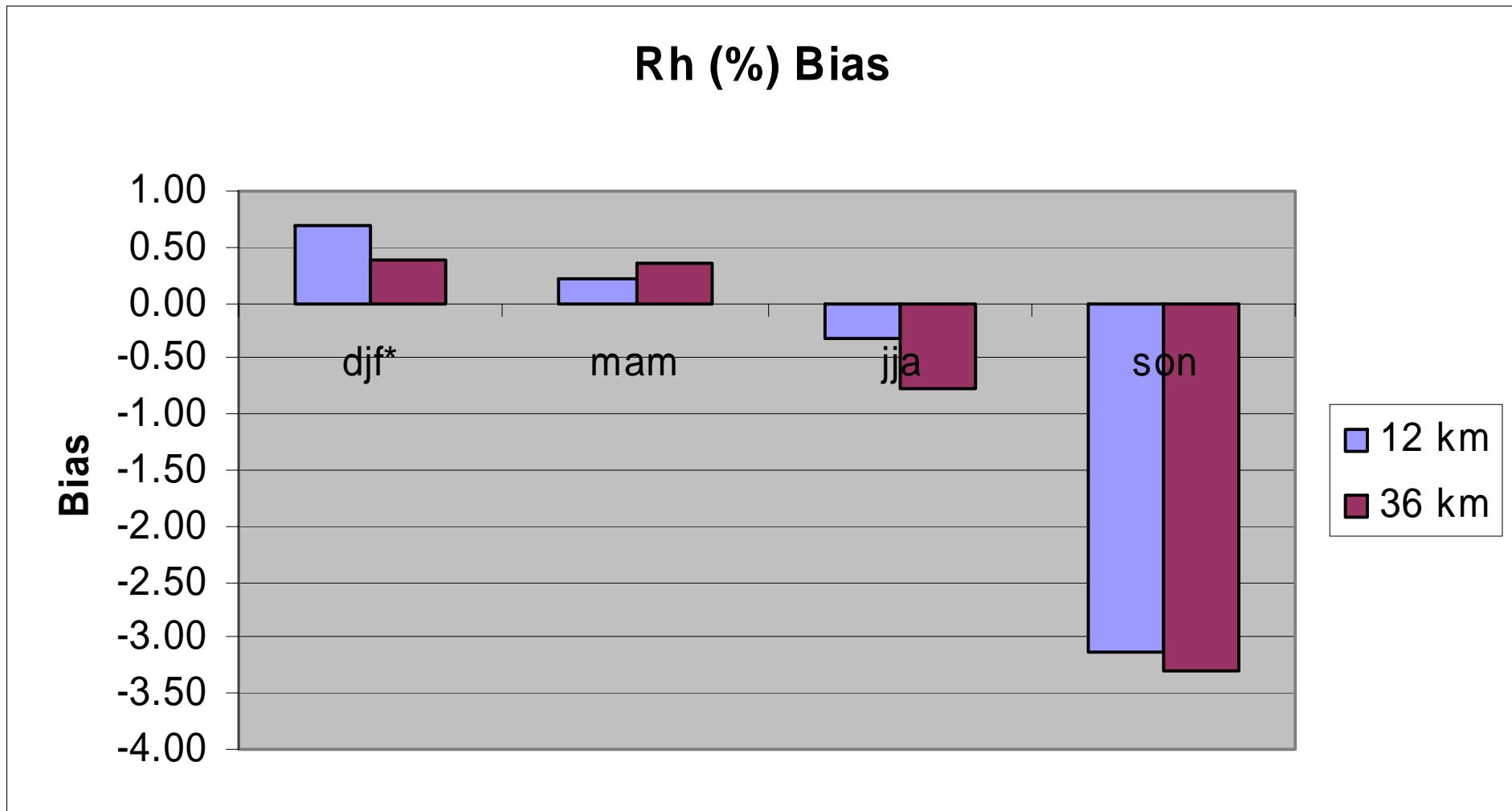
Day/night VISTAS stats, 12km



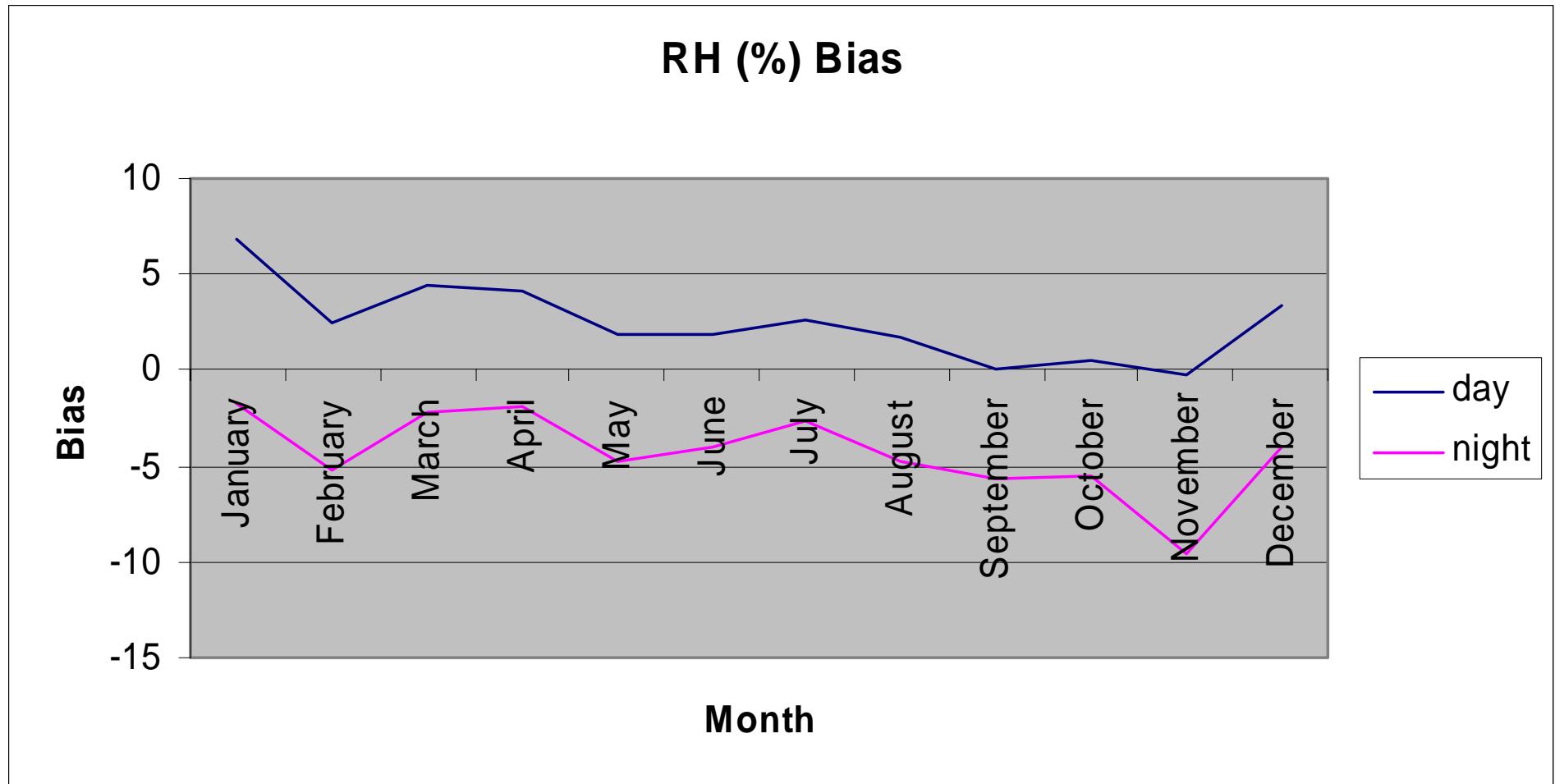
Monthly VISTAS stats



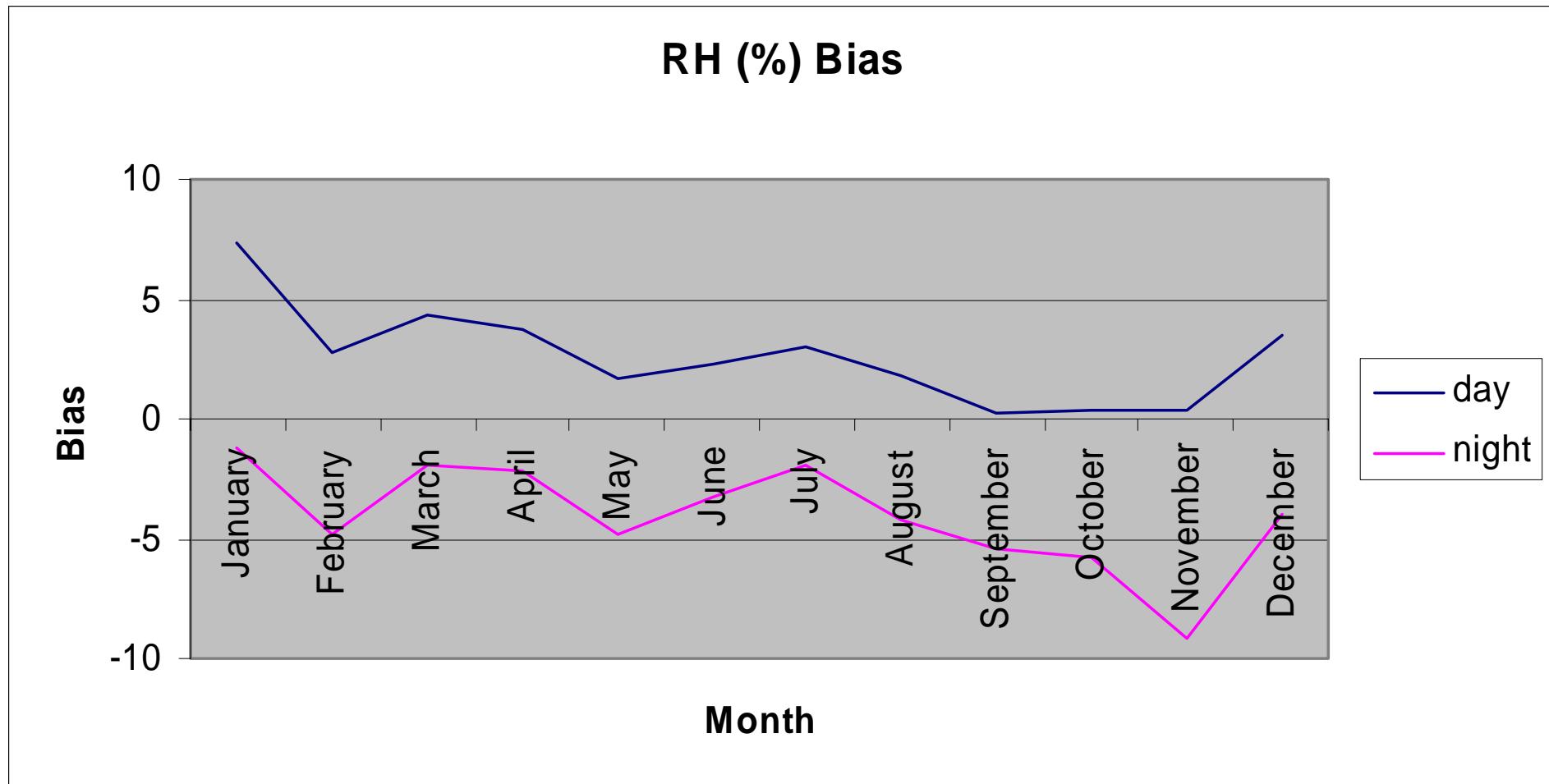
Seasonal VISTAS stats



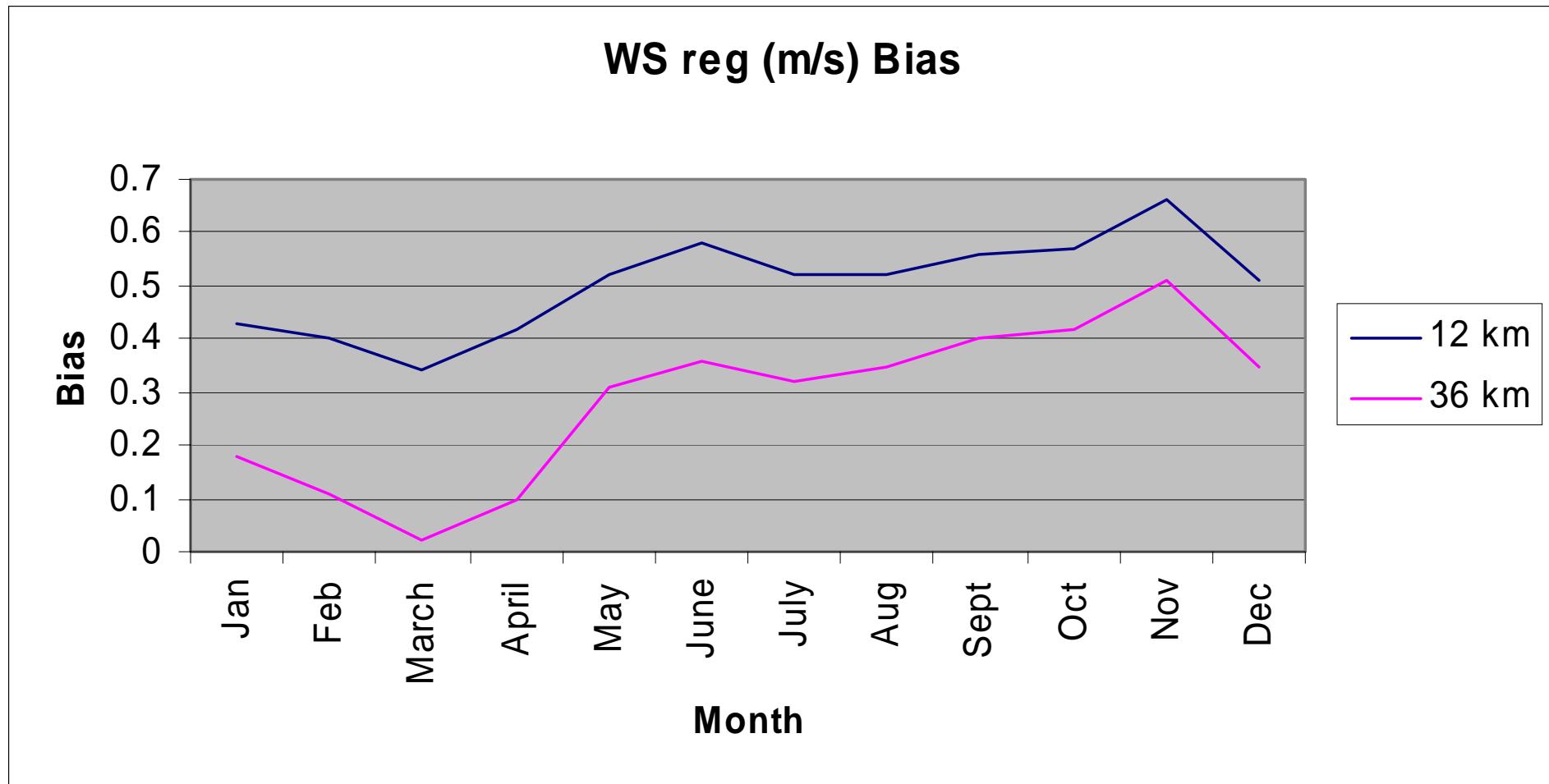
Day/night VISTAS stats, 36km



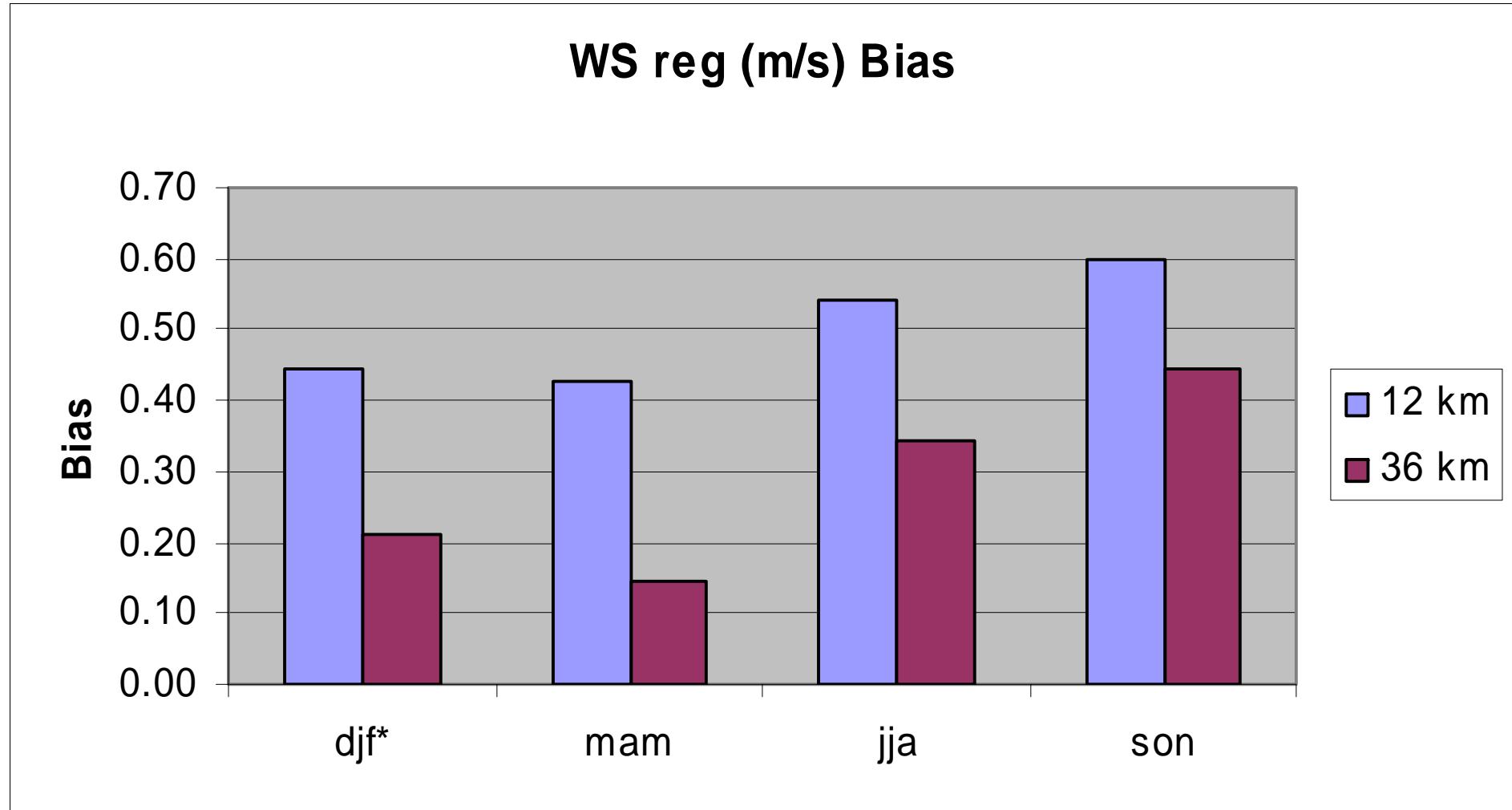
Day/night VISTAS stats, 12km



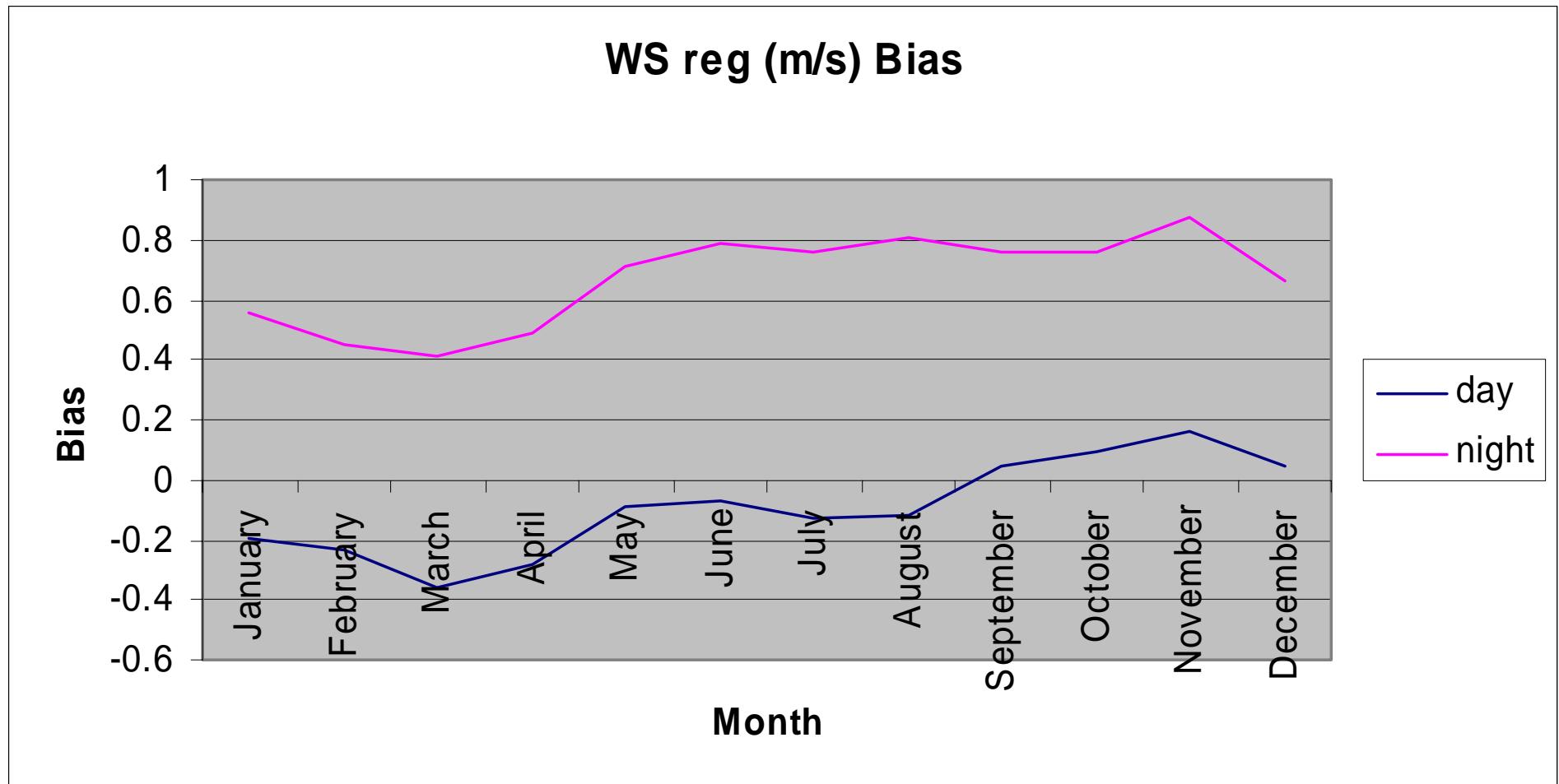
Monthly VISTAS stats



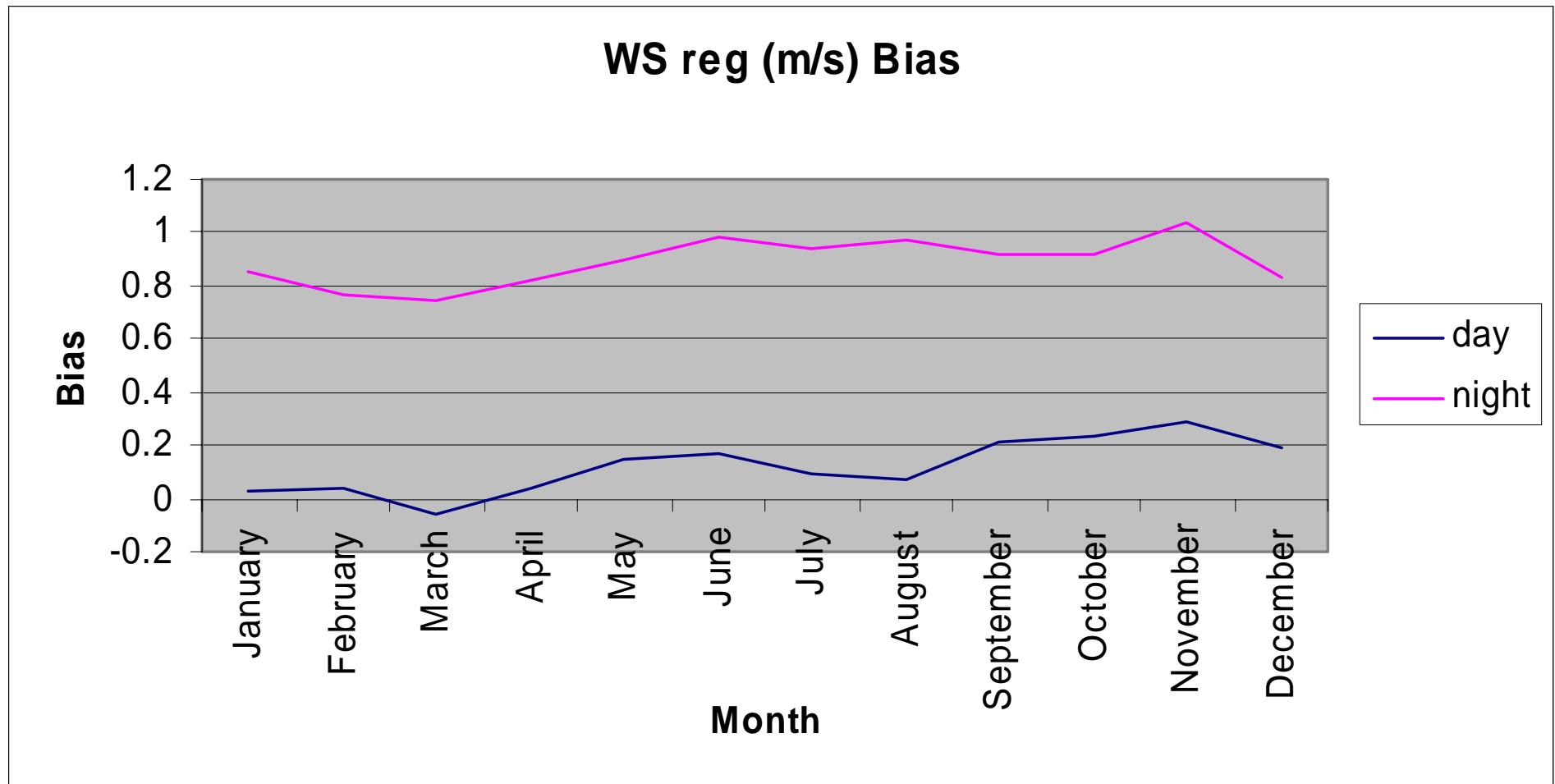
Seasonal VISTAS stats



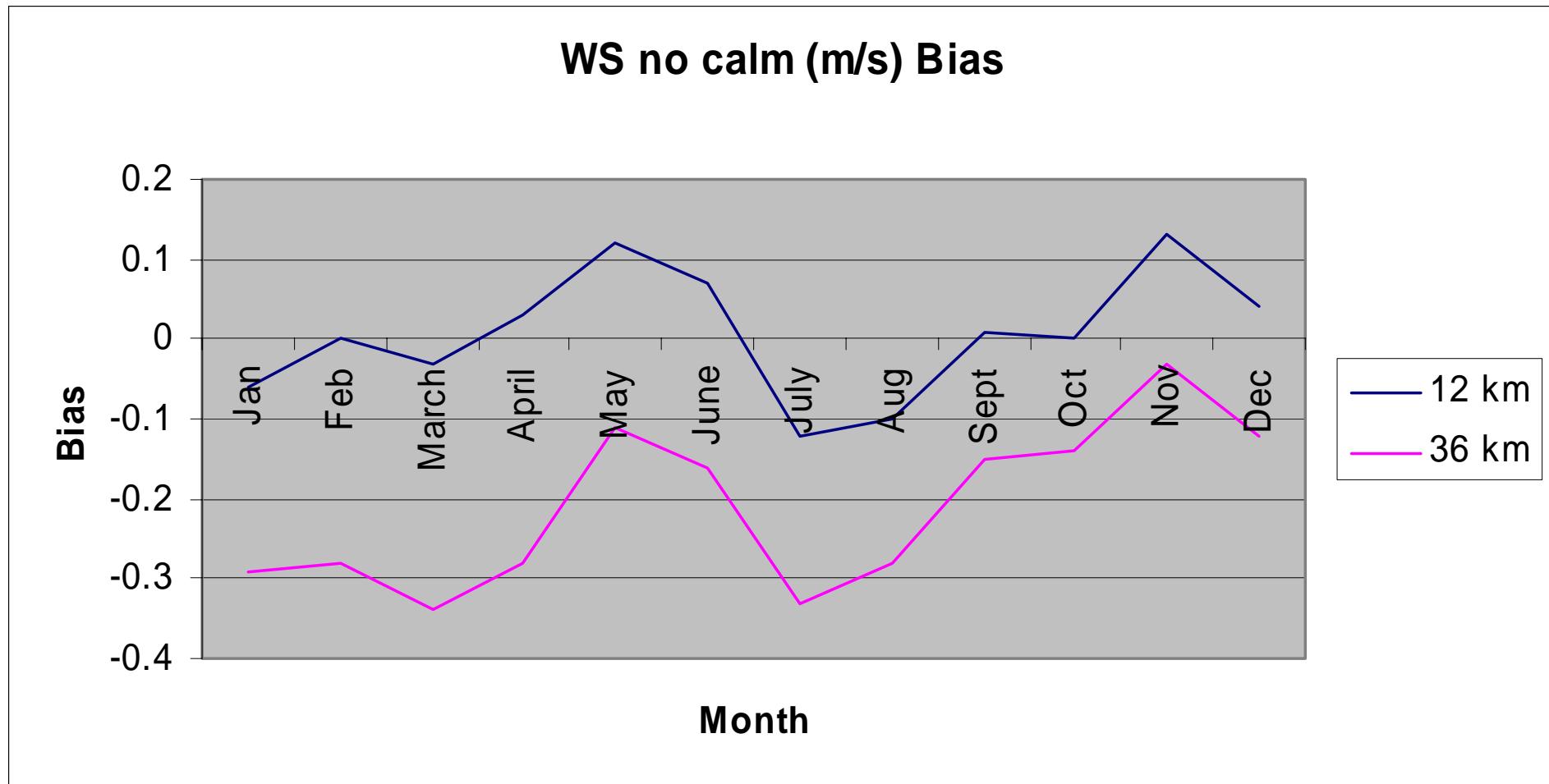
Day/night VISTAS stats, 36km



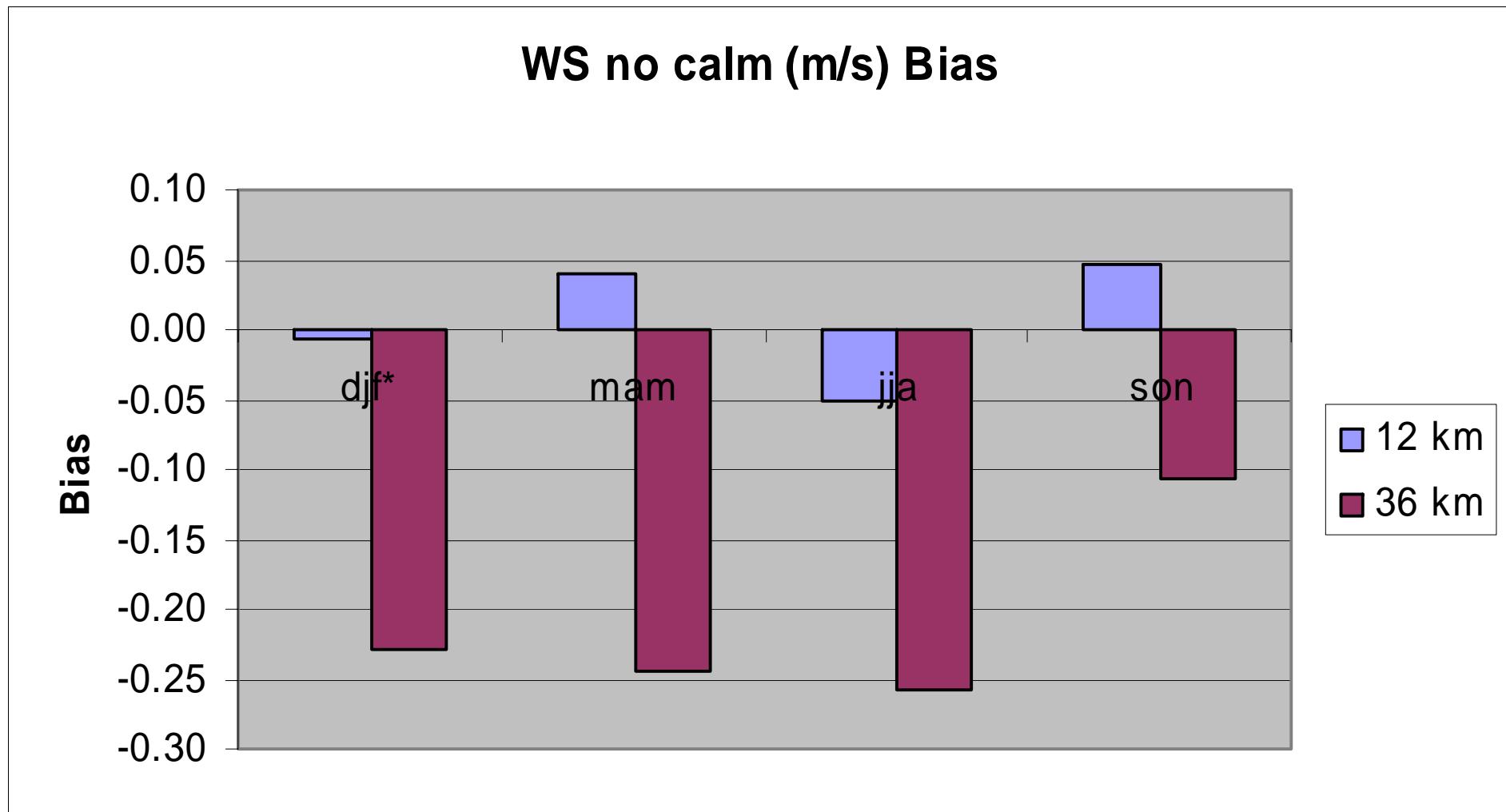
Day/night VISTAS stats, 12km



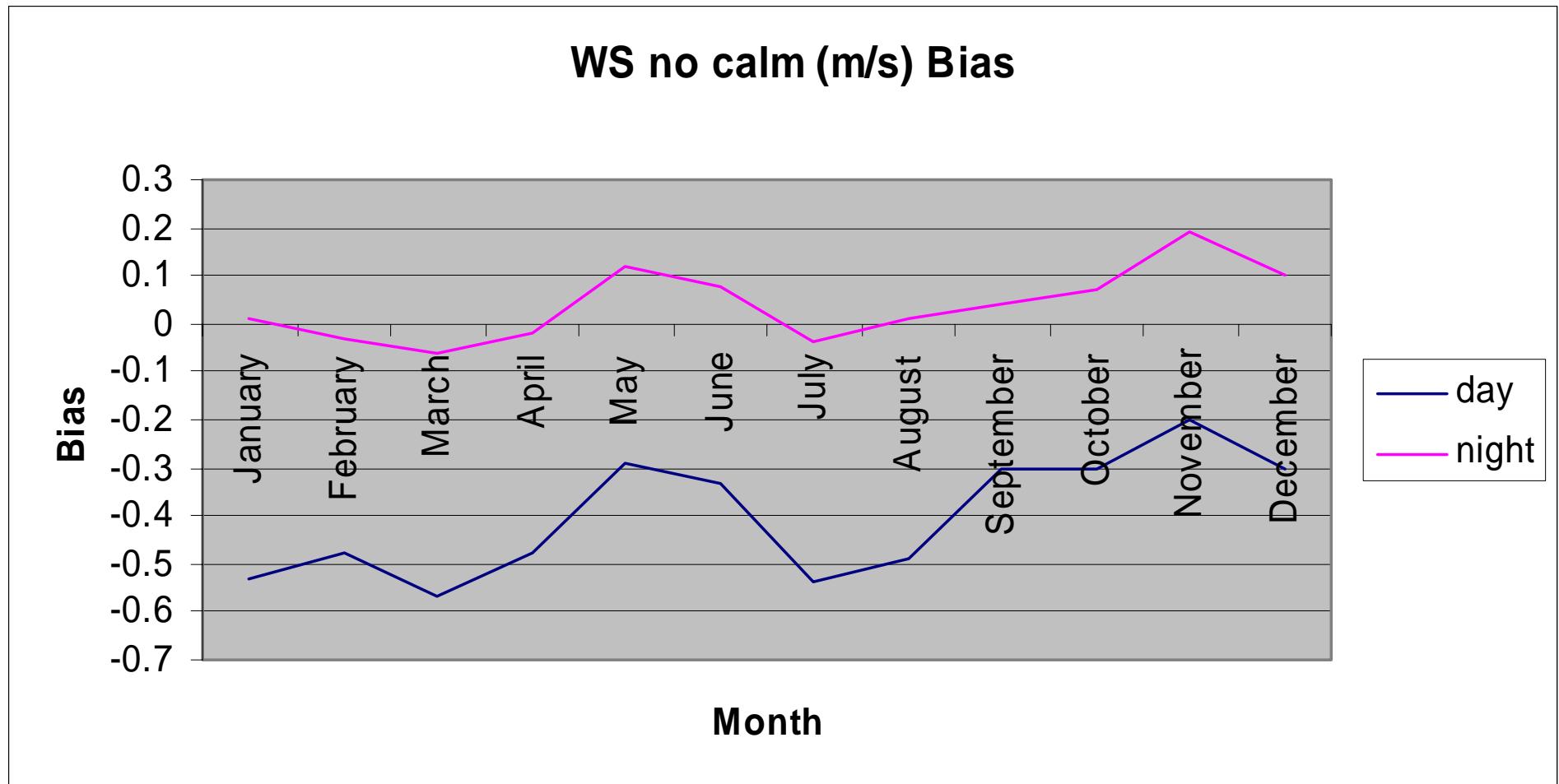
Monthly VISTAS stats



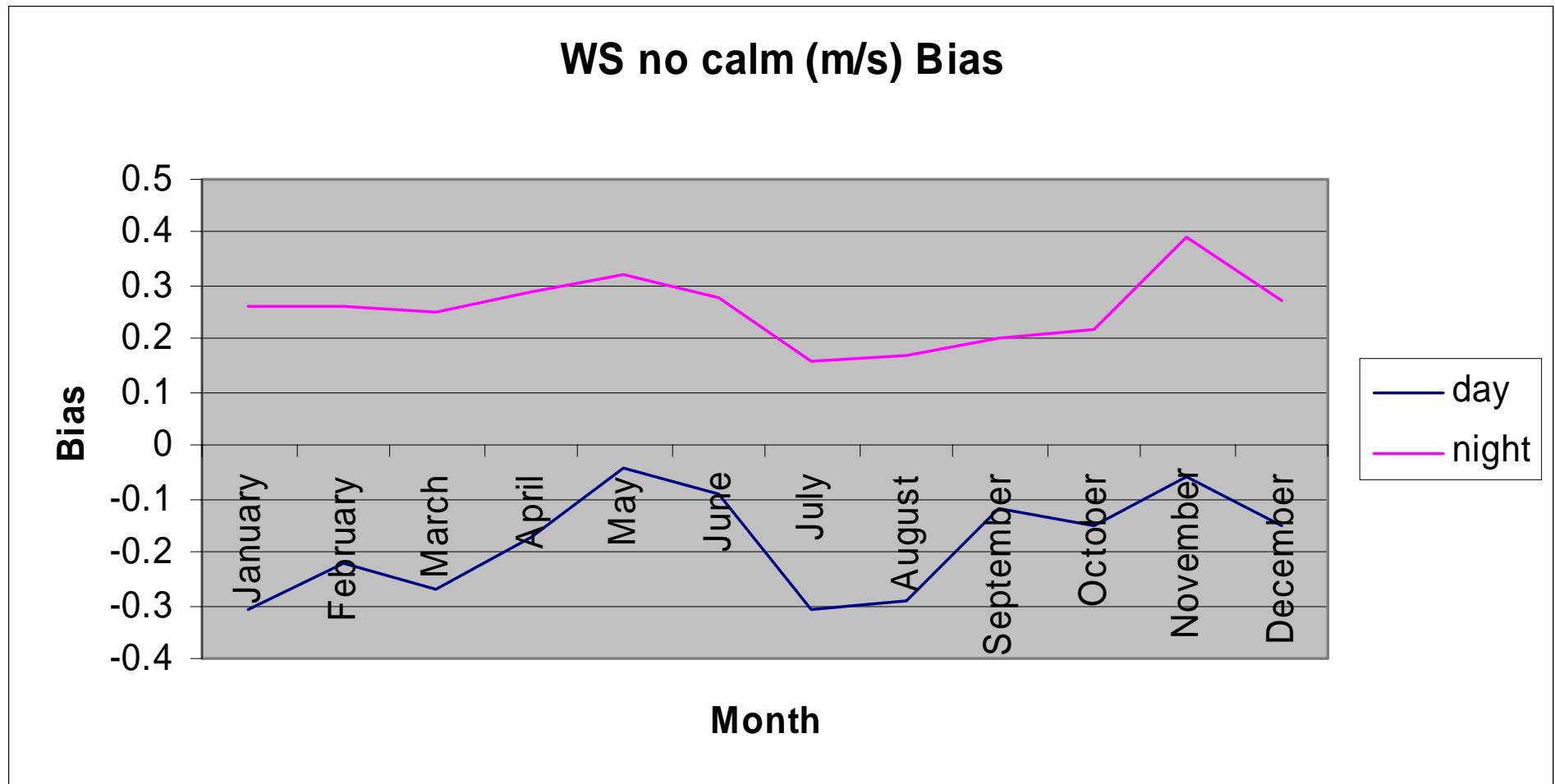
Seasonal VISTAS stats



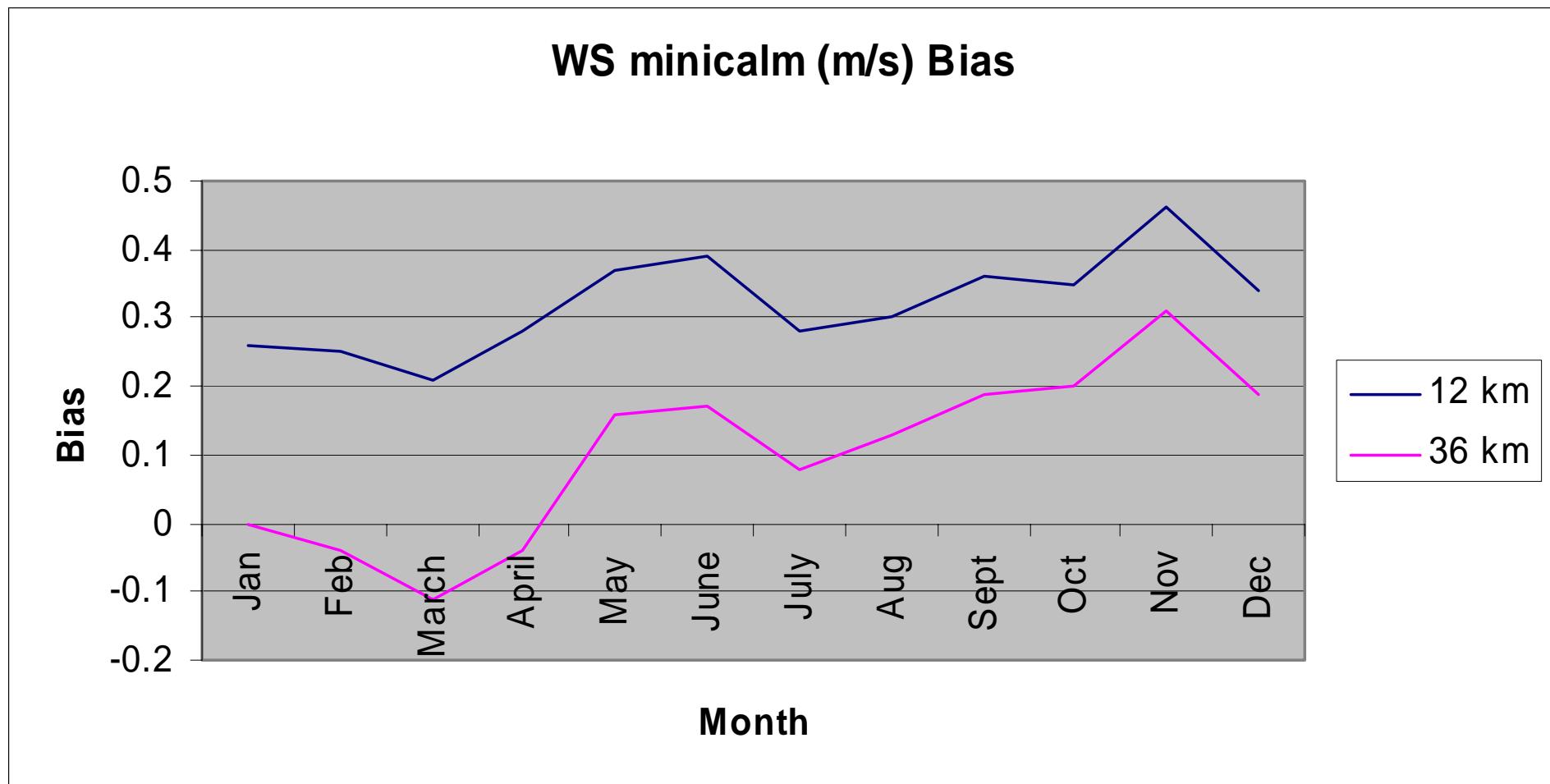
Day/night VISTAS stats, 36km



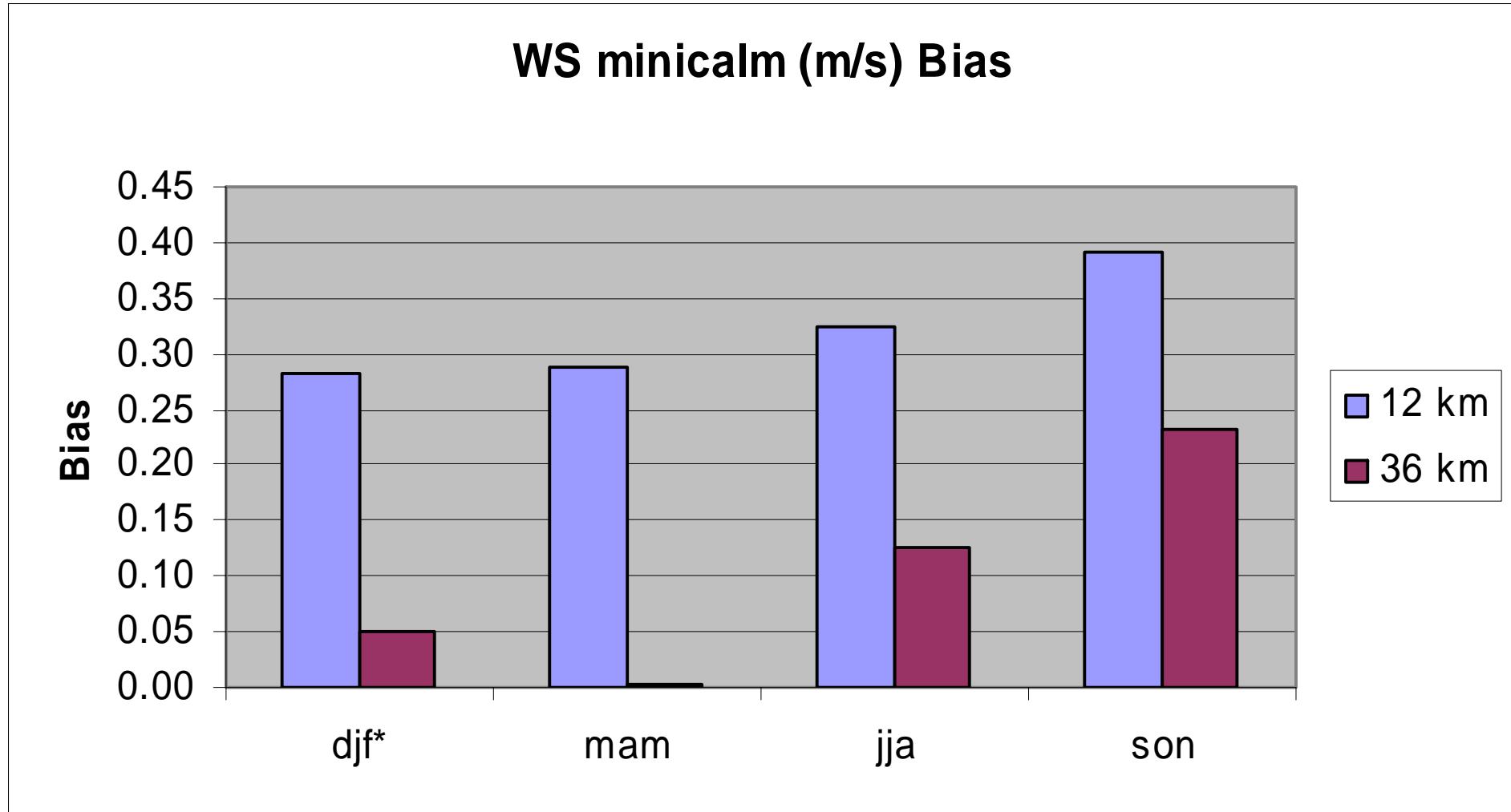
Day/night VISTAS stats, 12km



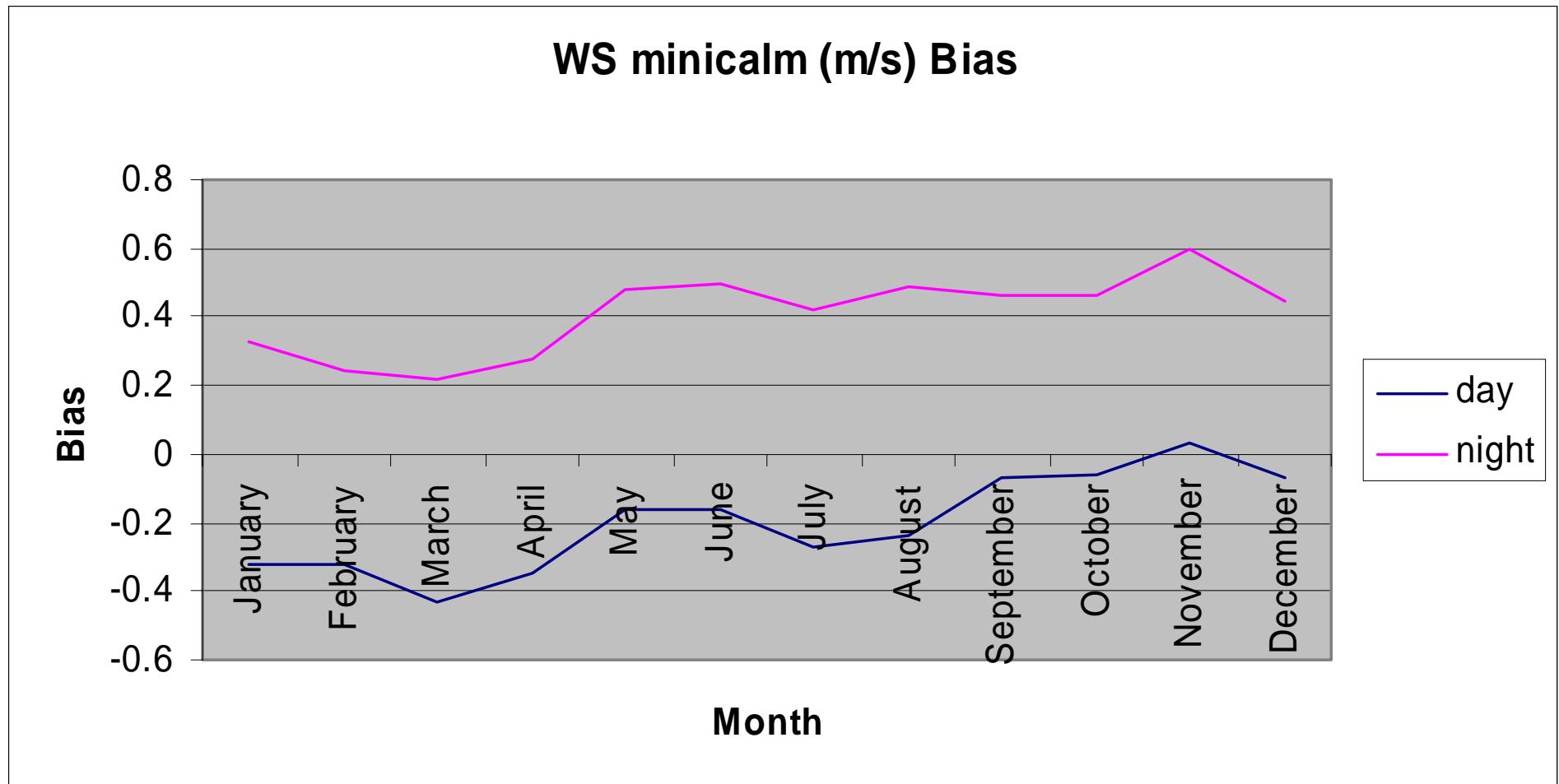
Monthly VISTAS stats



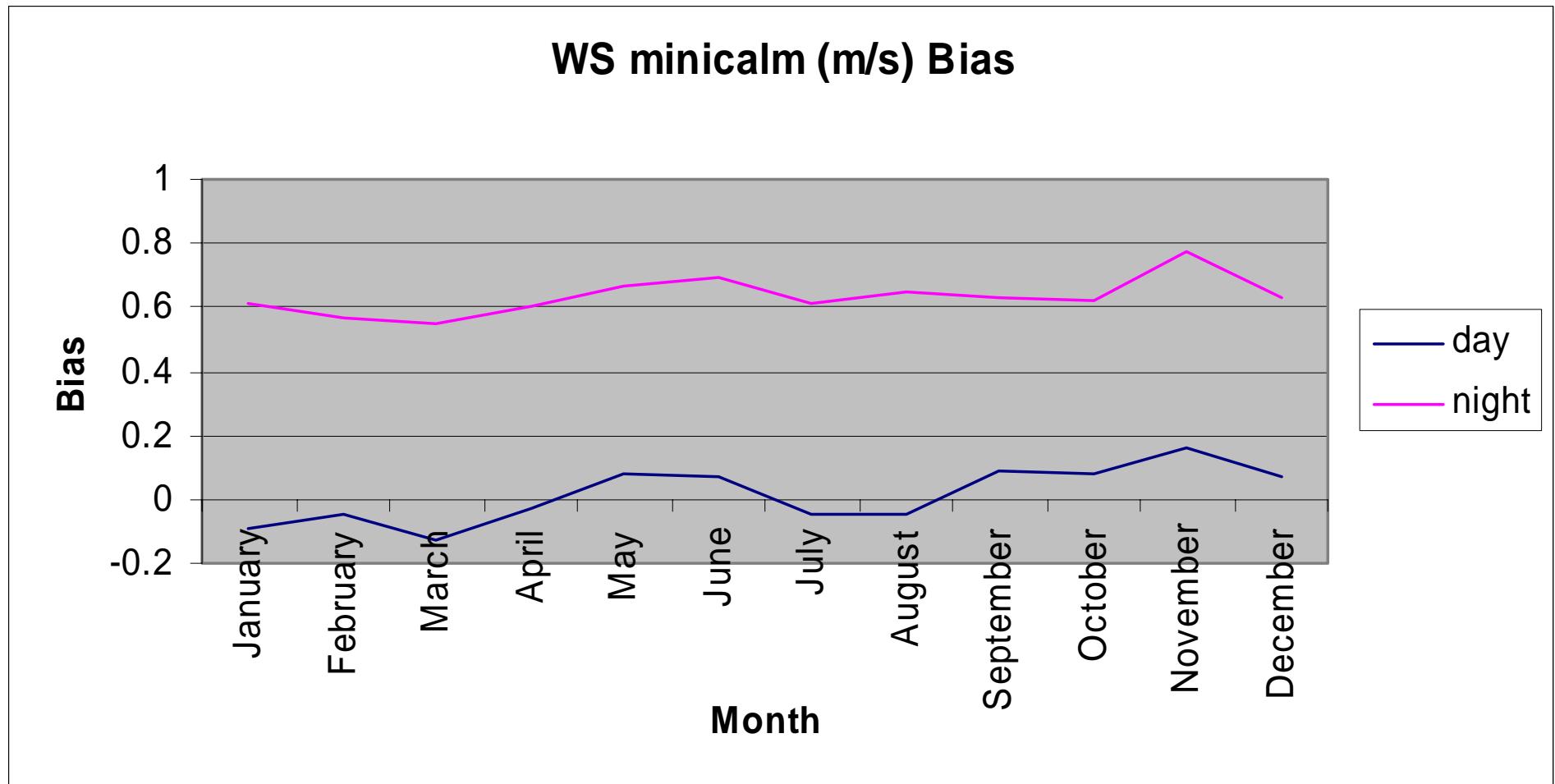
Seasonal VISTAS stats



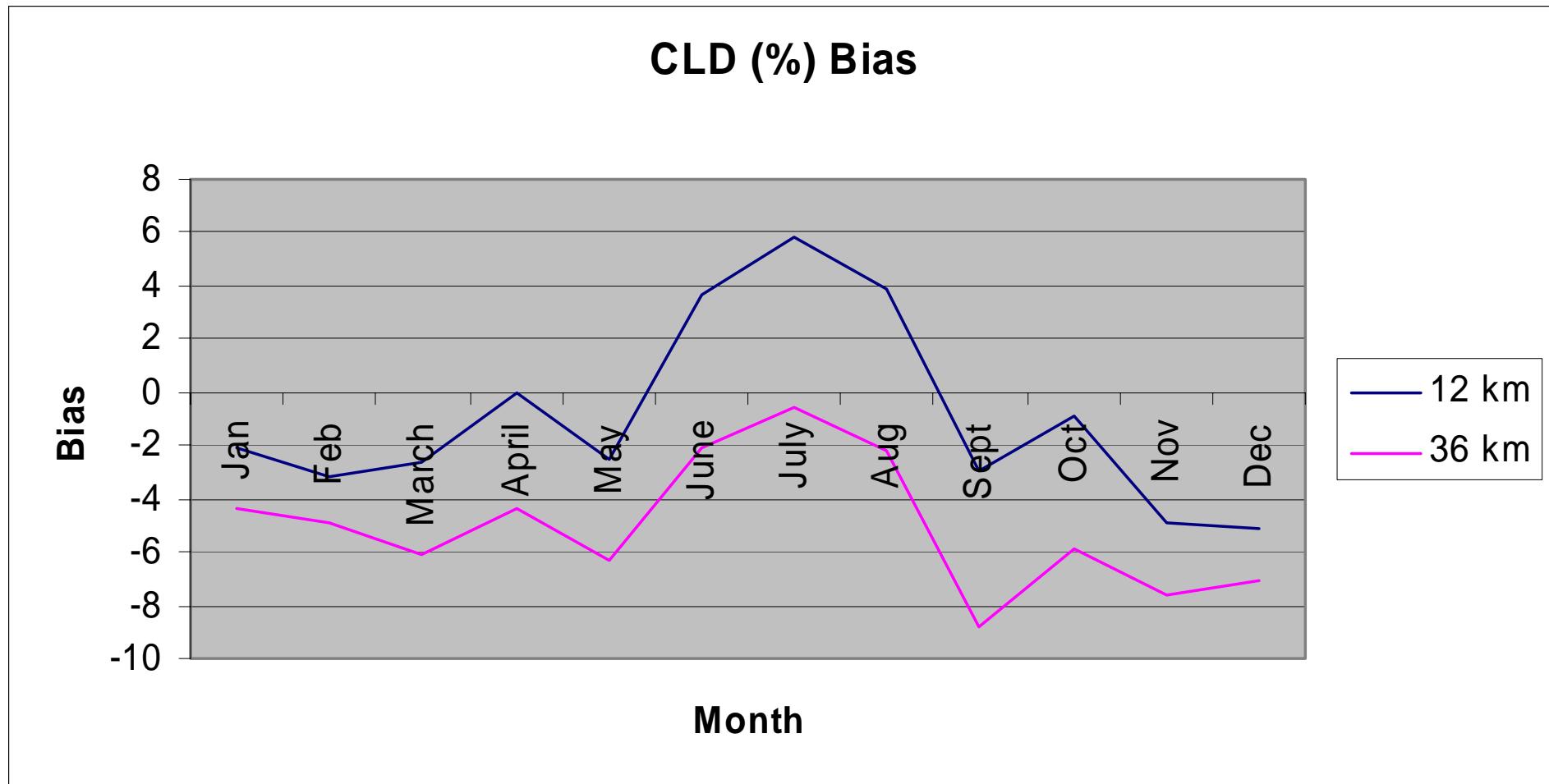
Day/night VISTAS stats, 36km



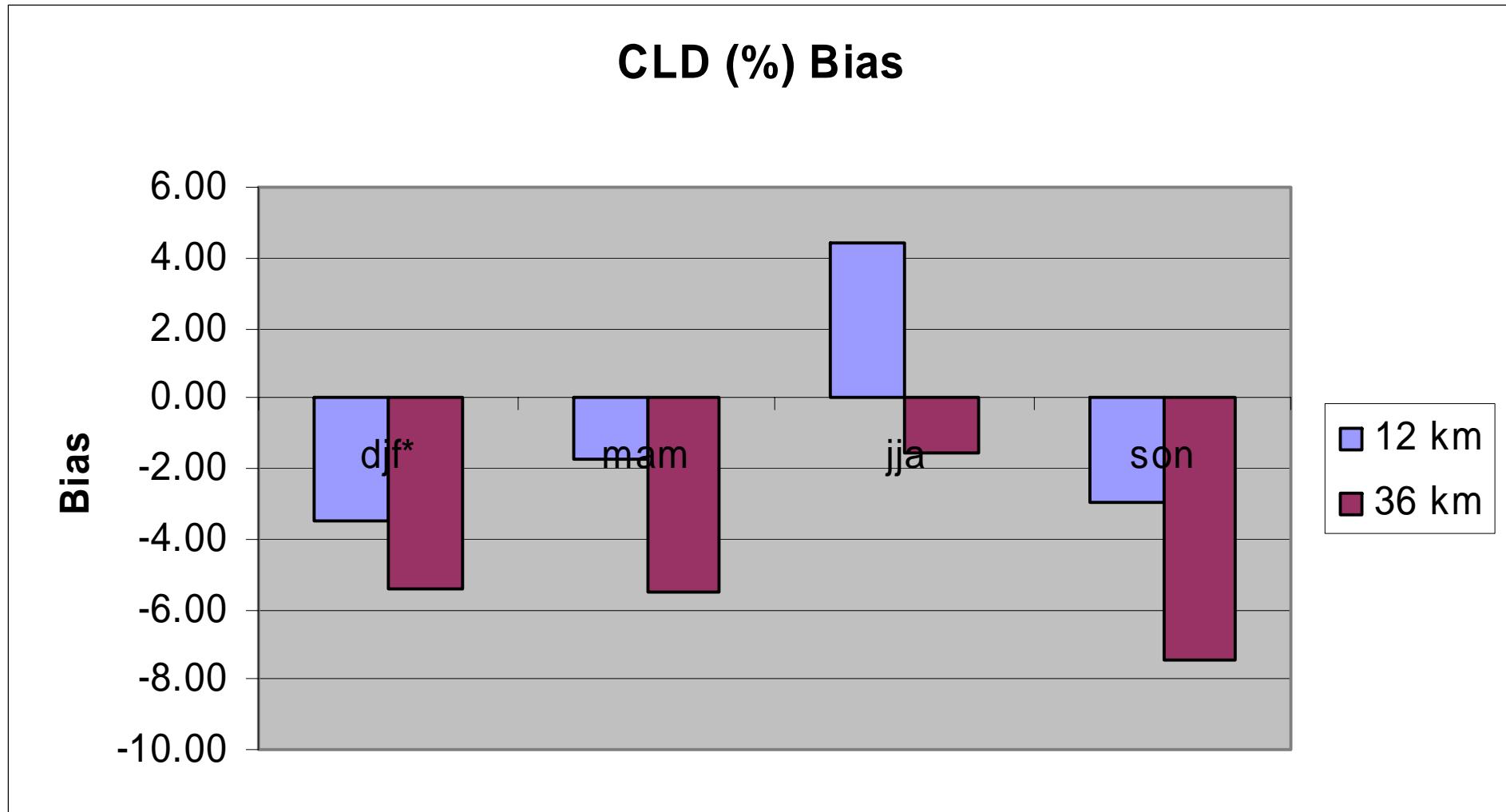
Day/night VISTAS stats, 12km



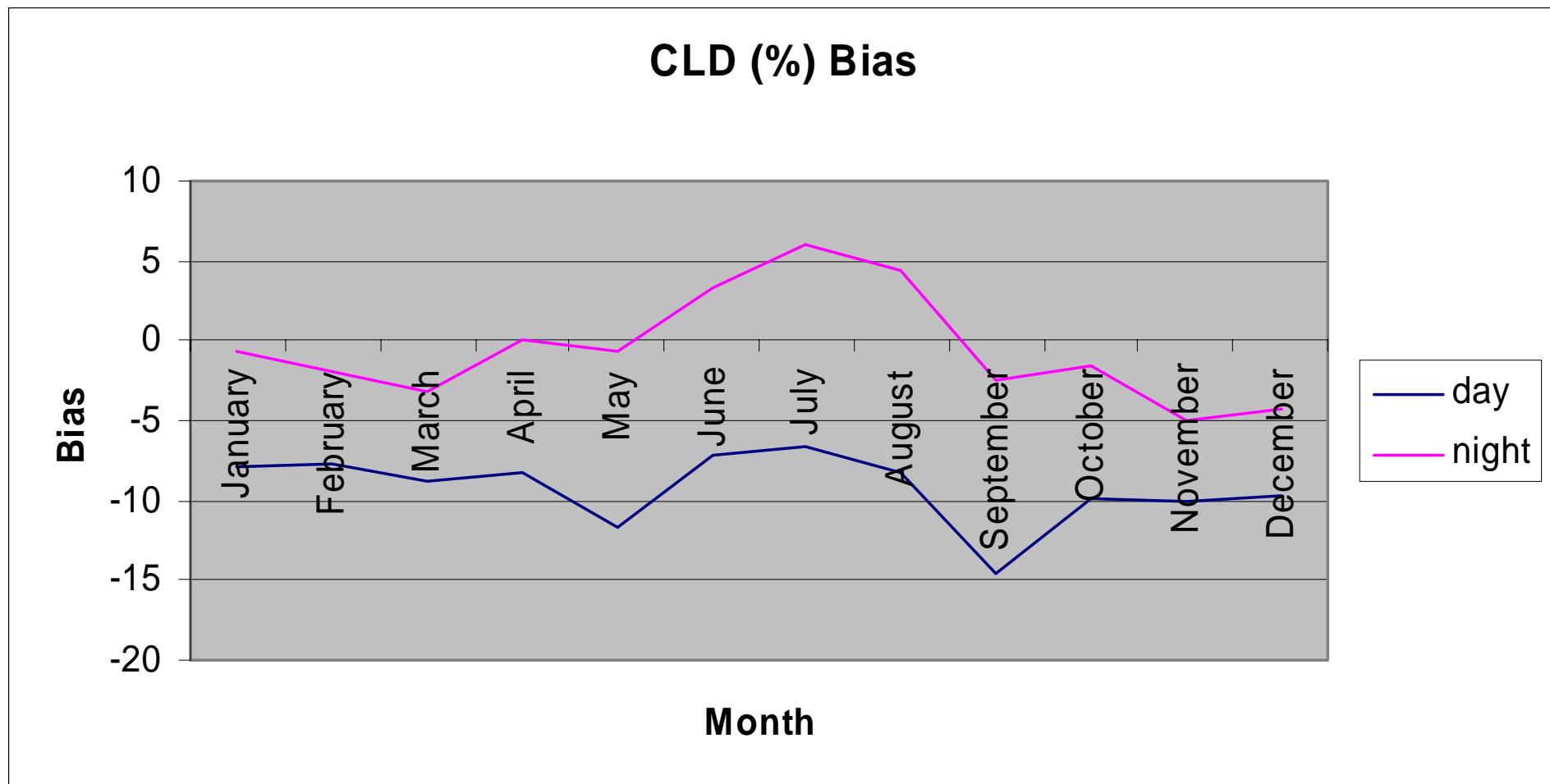
Monthly VISTAS stats



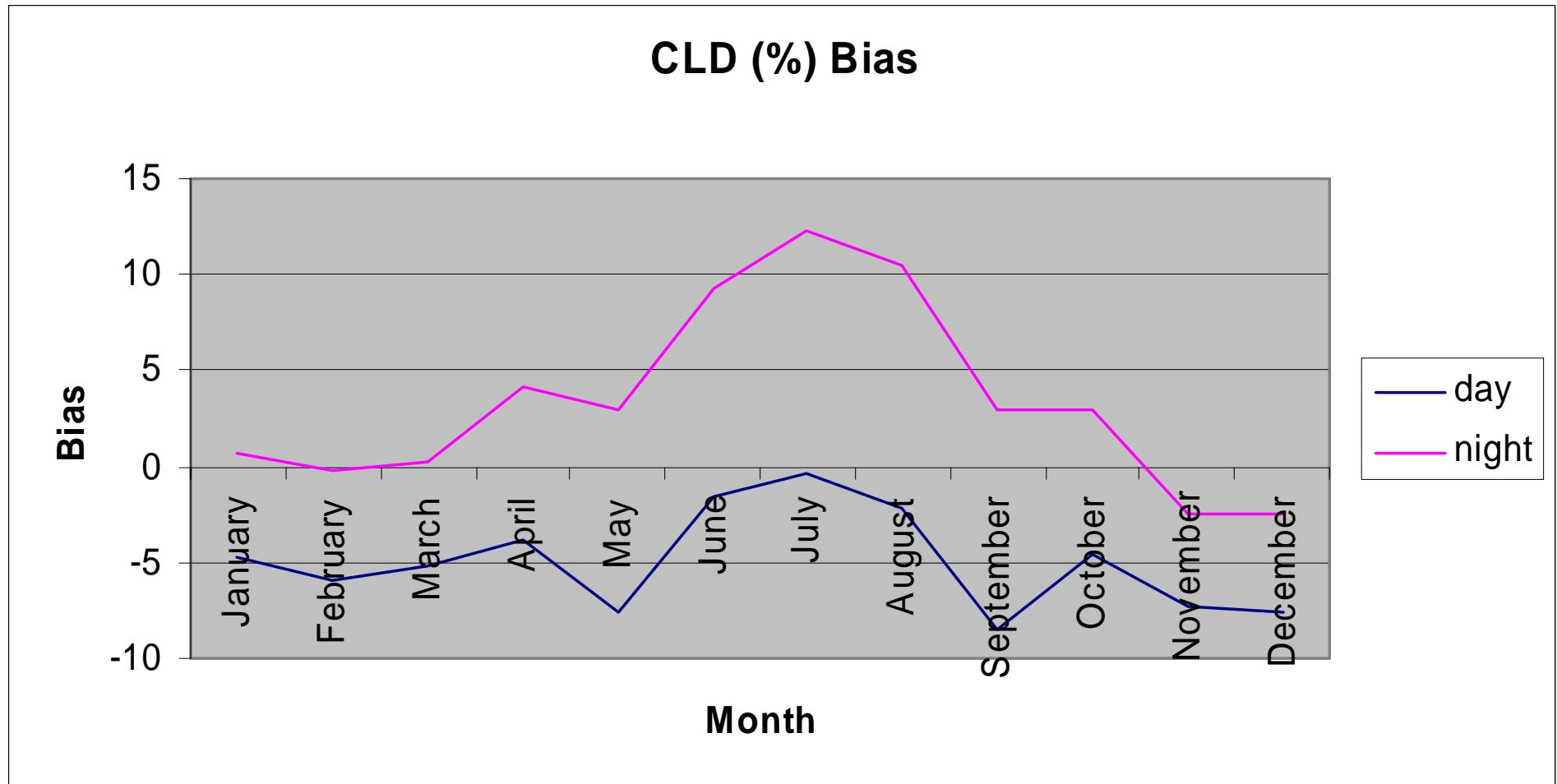
Seasonal VISTAS stats



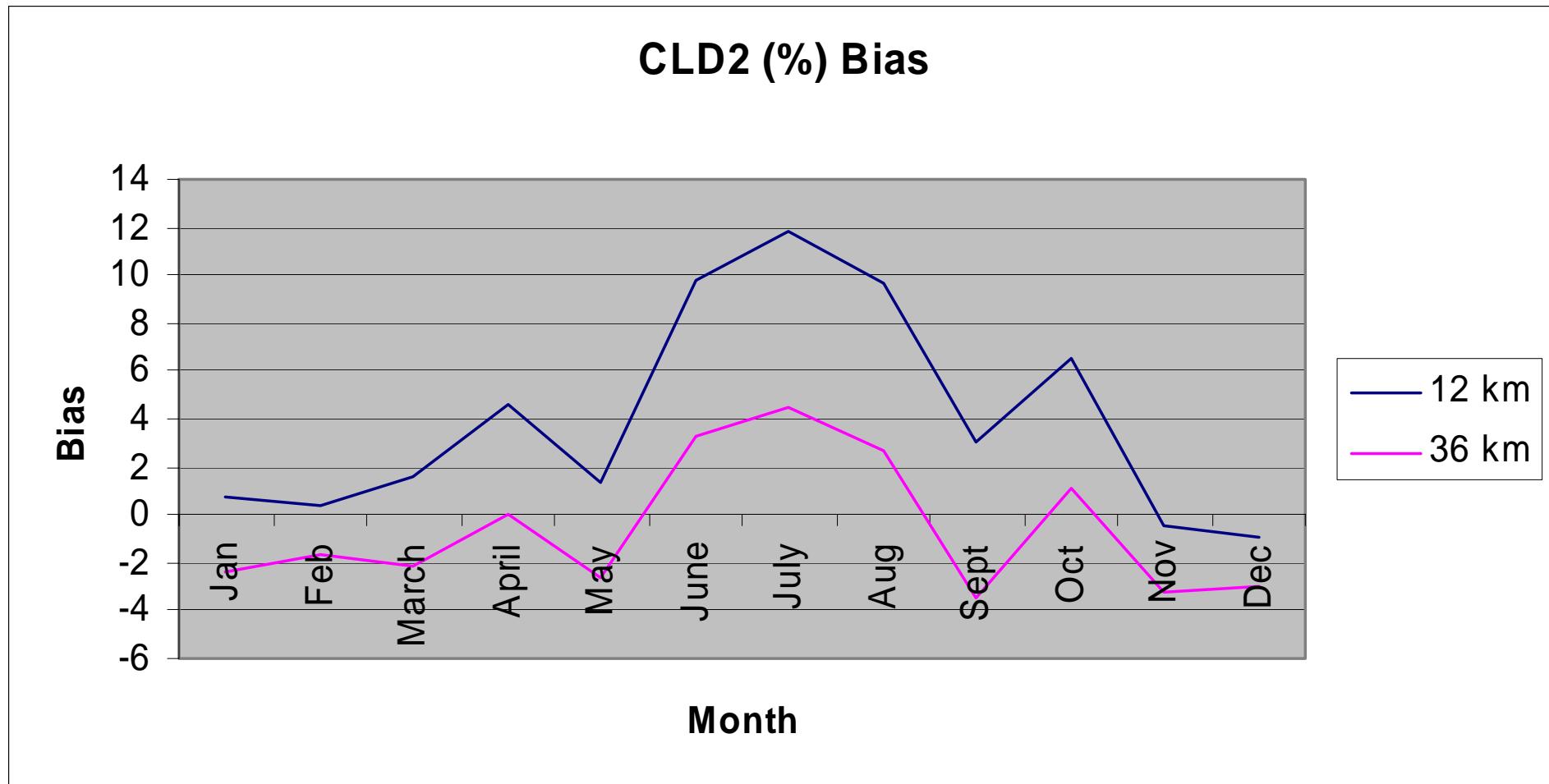
Day/night VISTAS stats, 36km



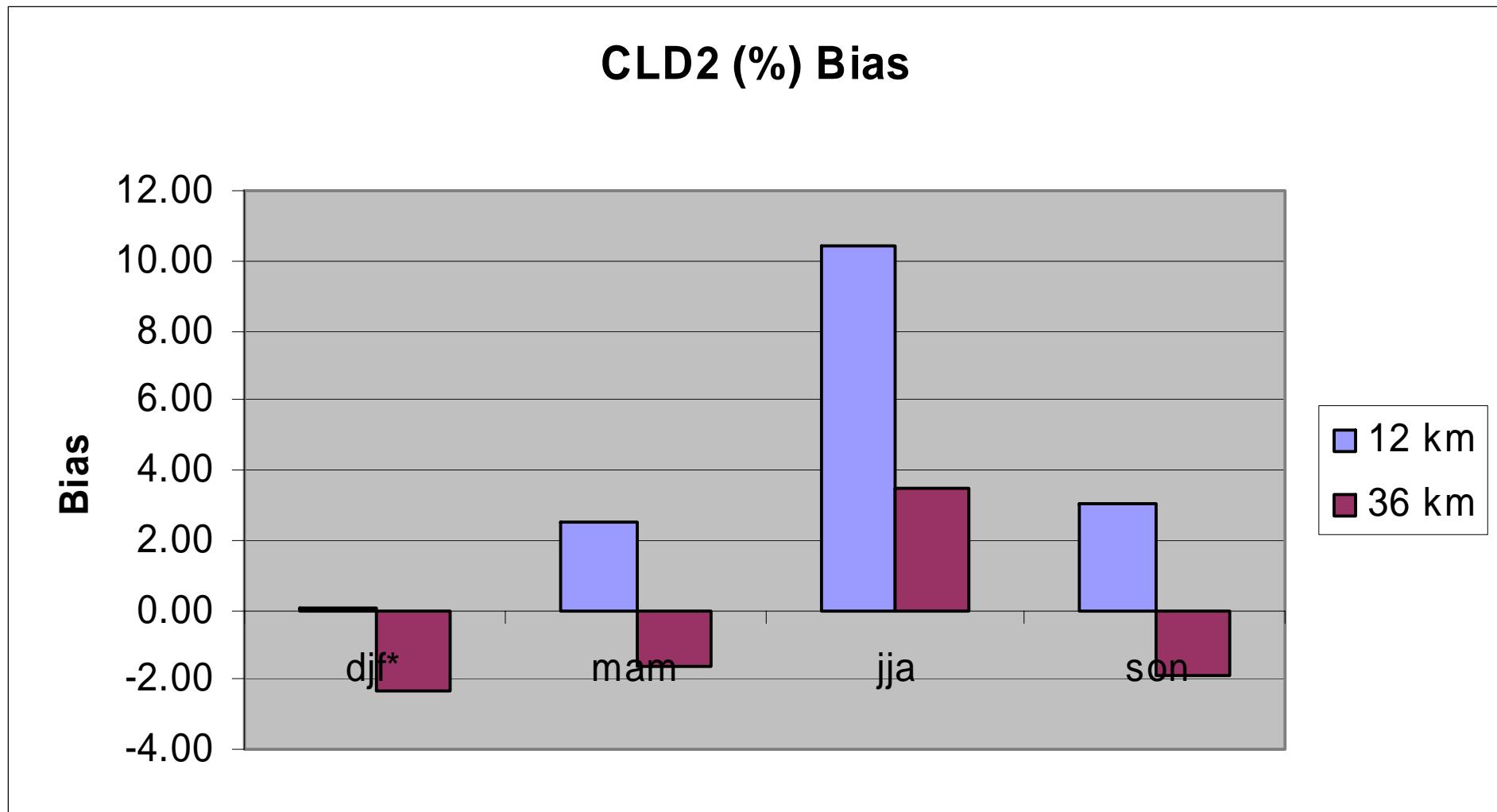
Day/night VISTAS stats, 12km



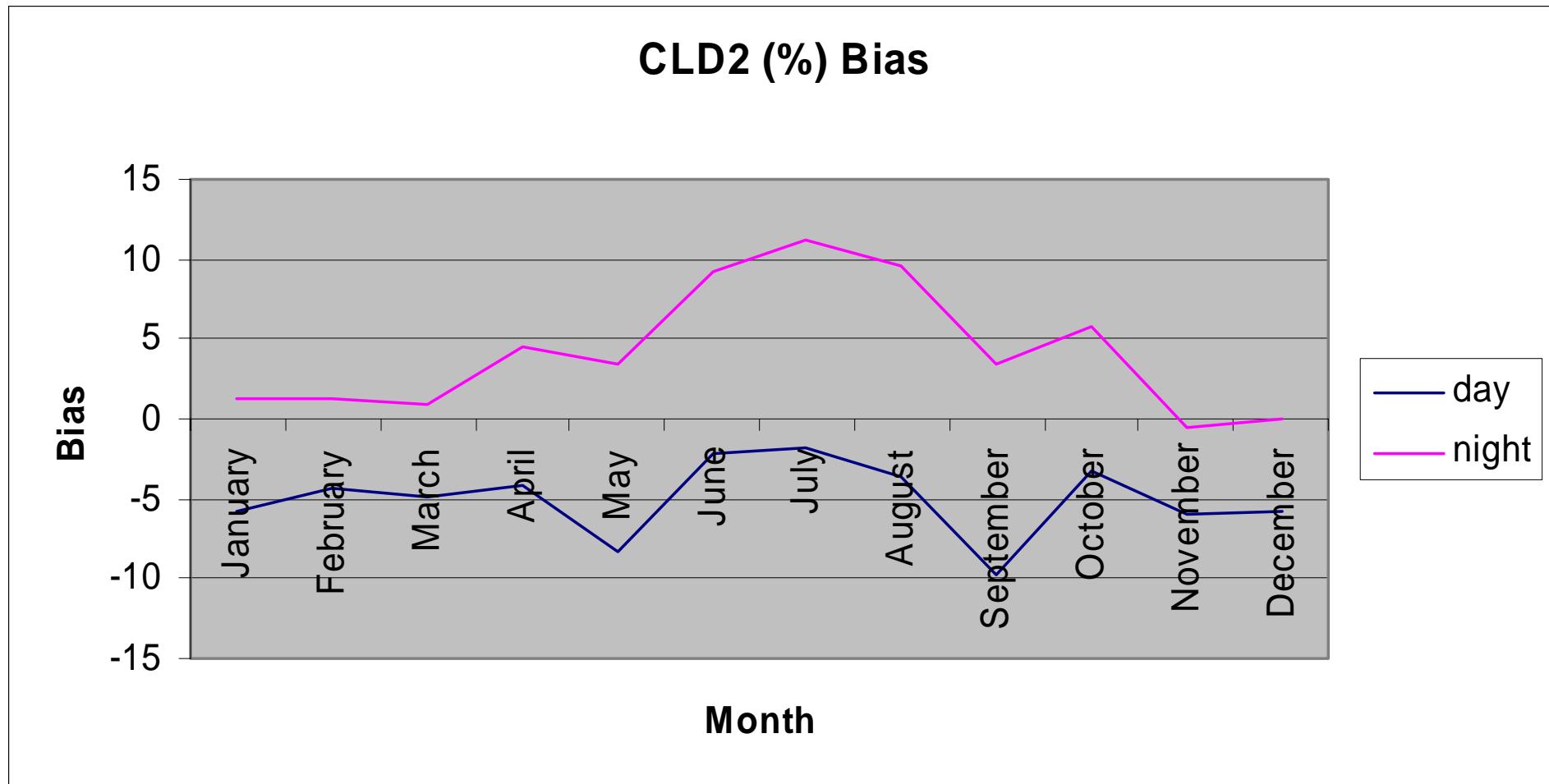
Monthly VISTAS stats



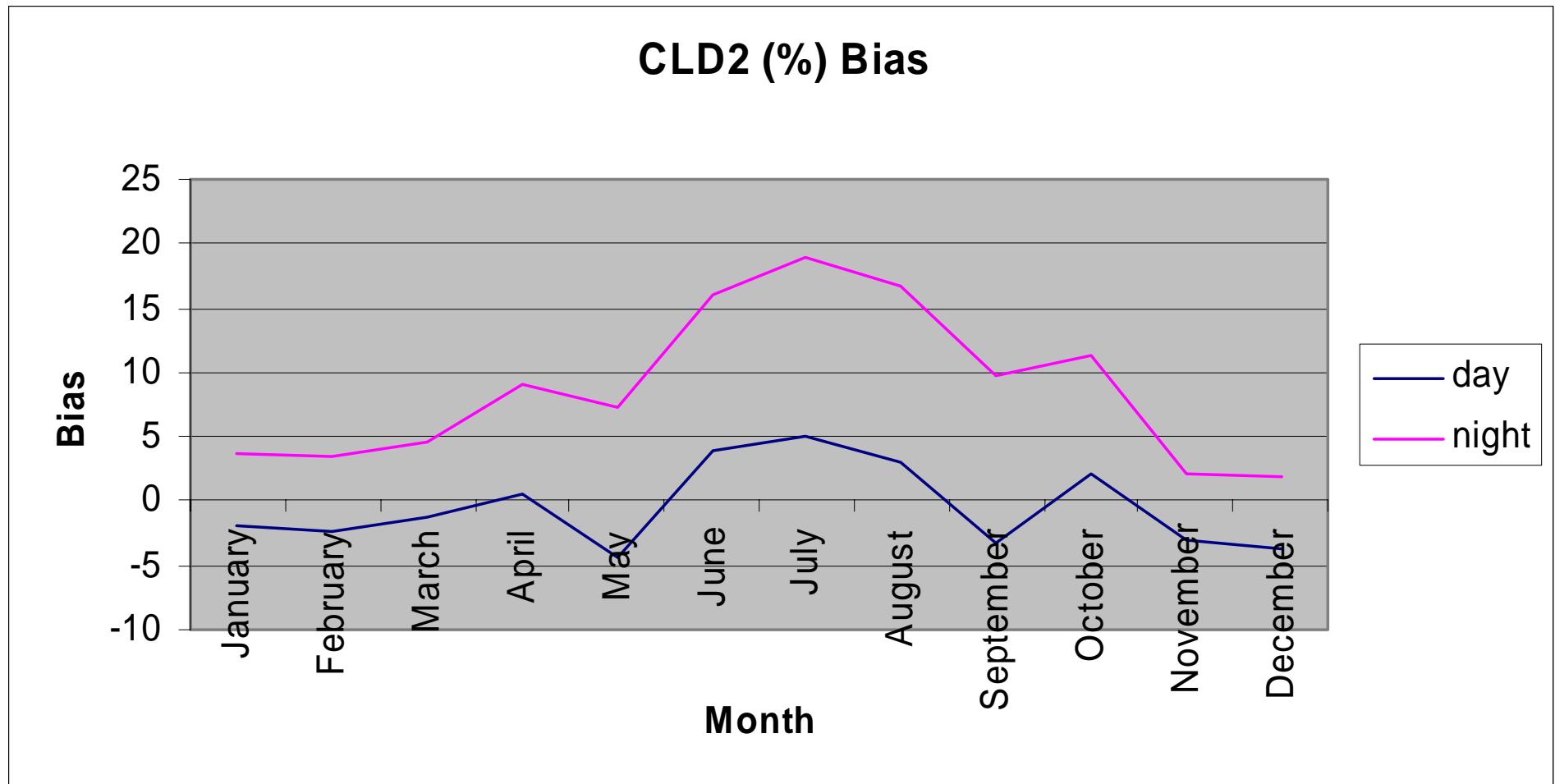
Seasonal VISTAS stats



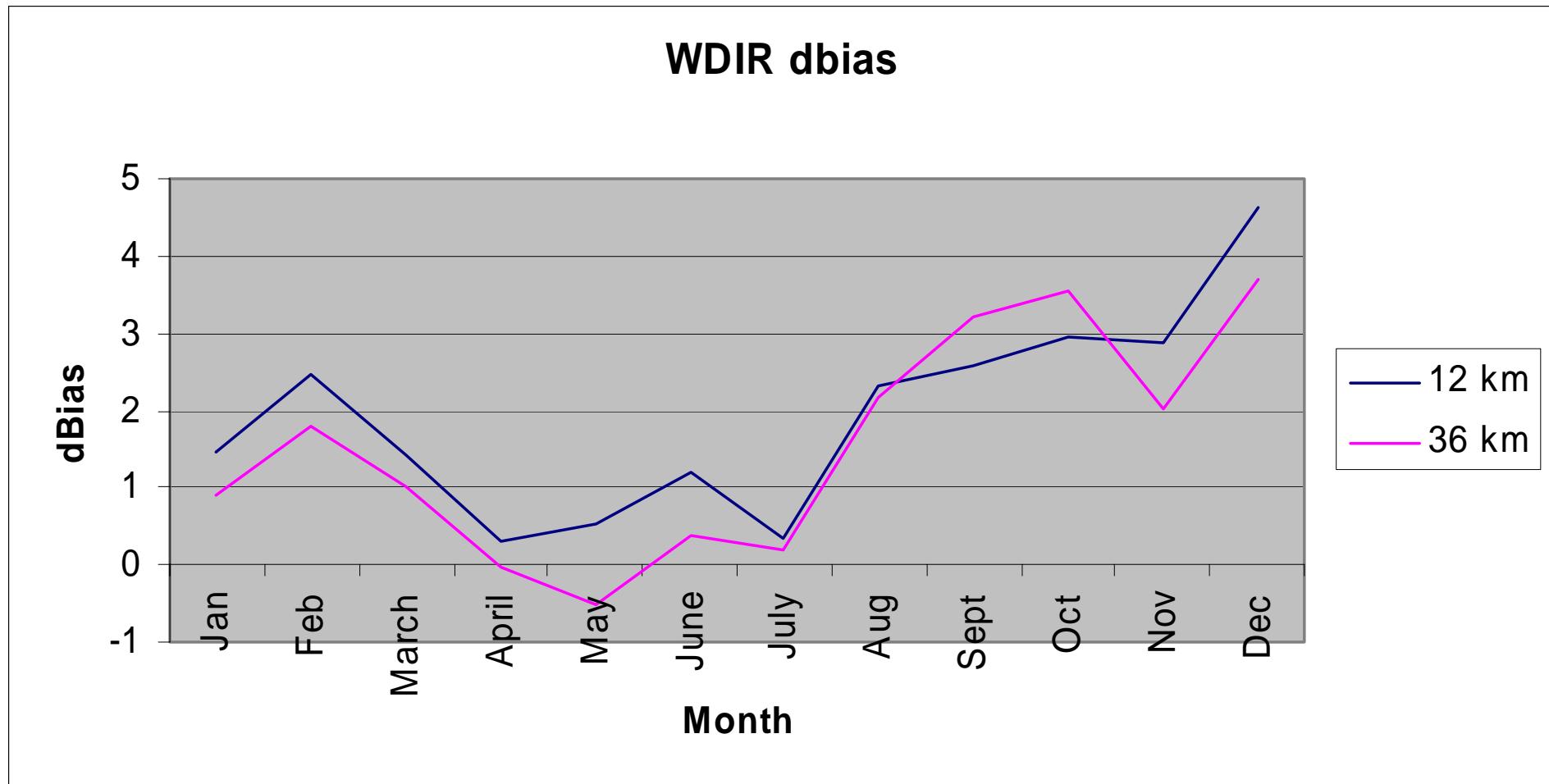
Day/night VISTAS stats, 36km



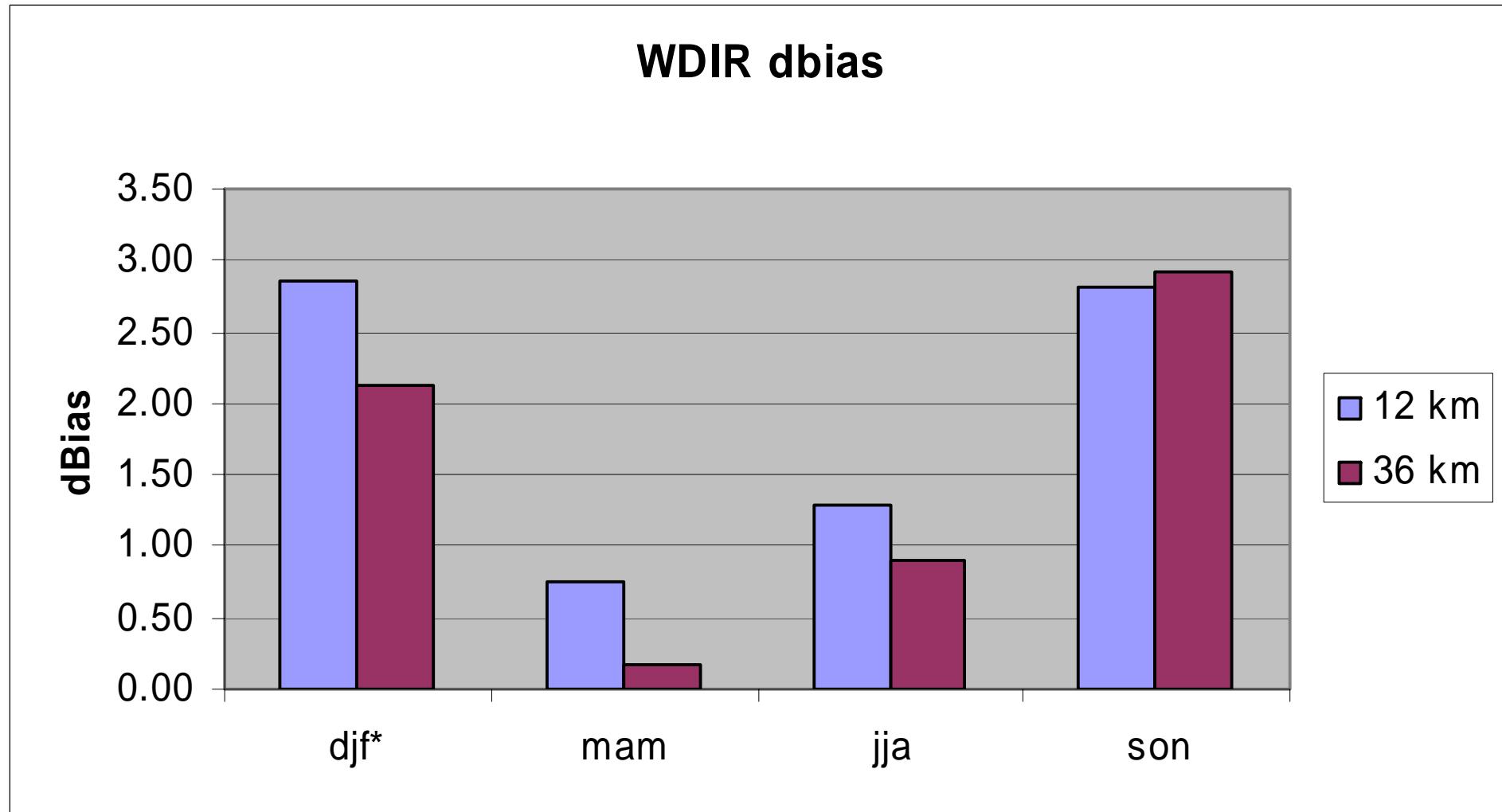
Day/night VISTAS stats, 12km



Monthly VISTAS stats



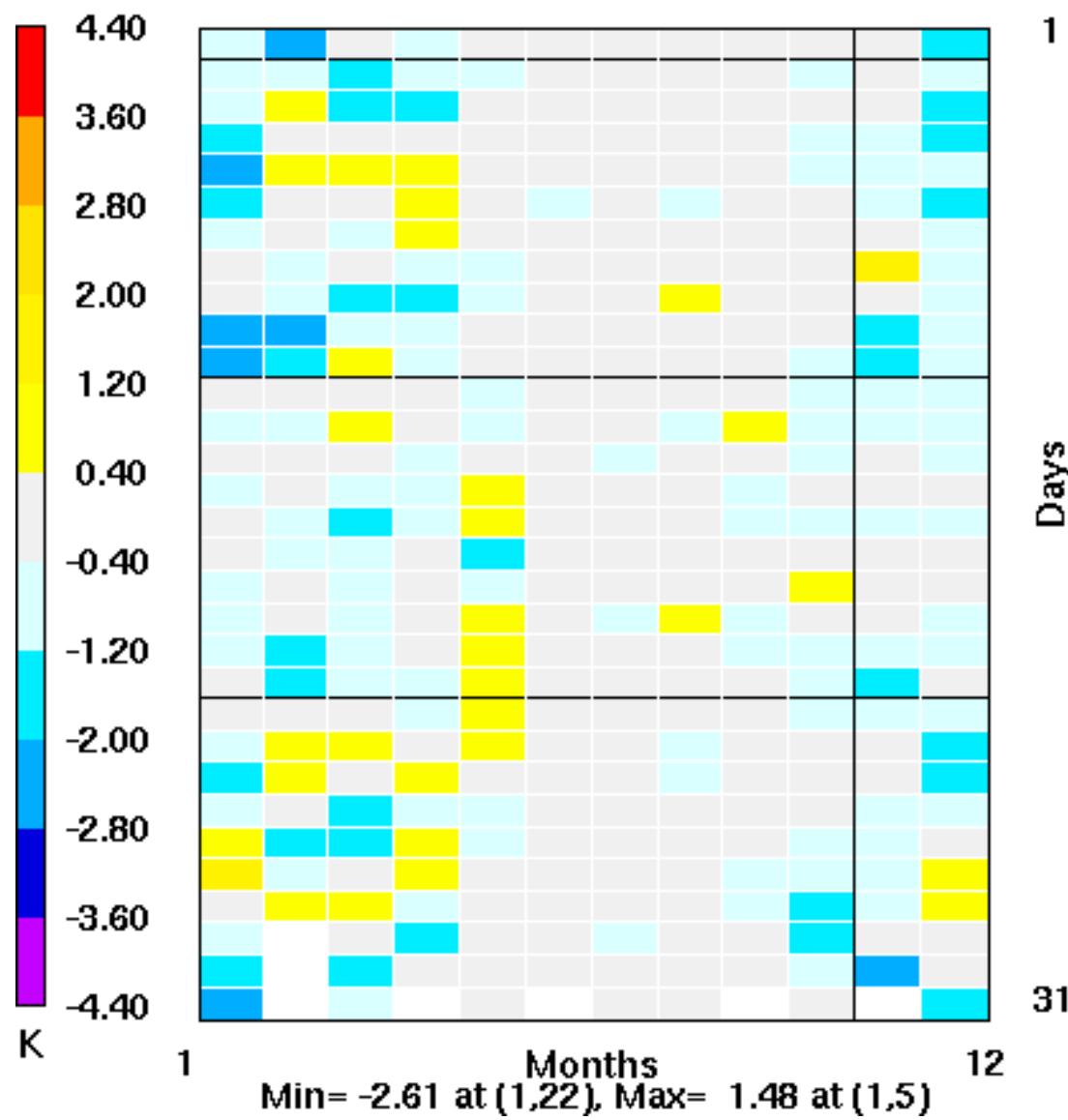
Seasonal VISTAS stats



Annual Bakergrams

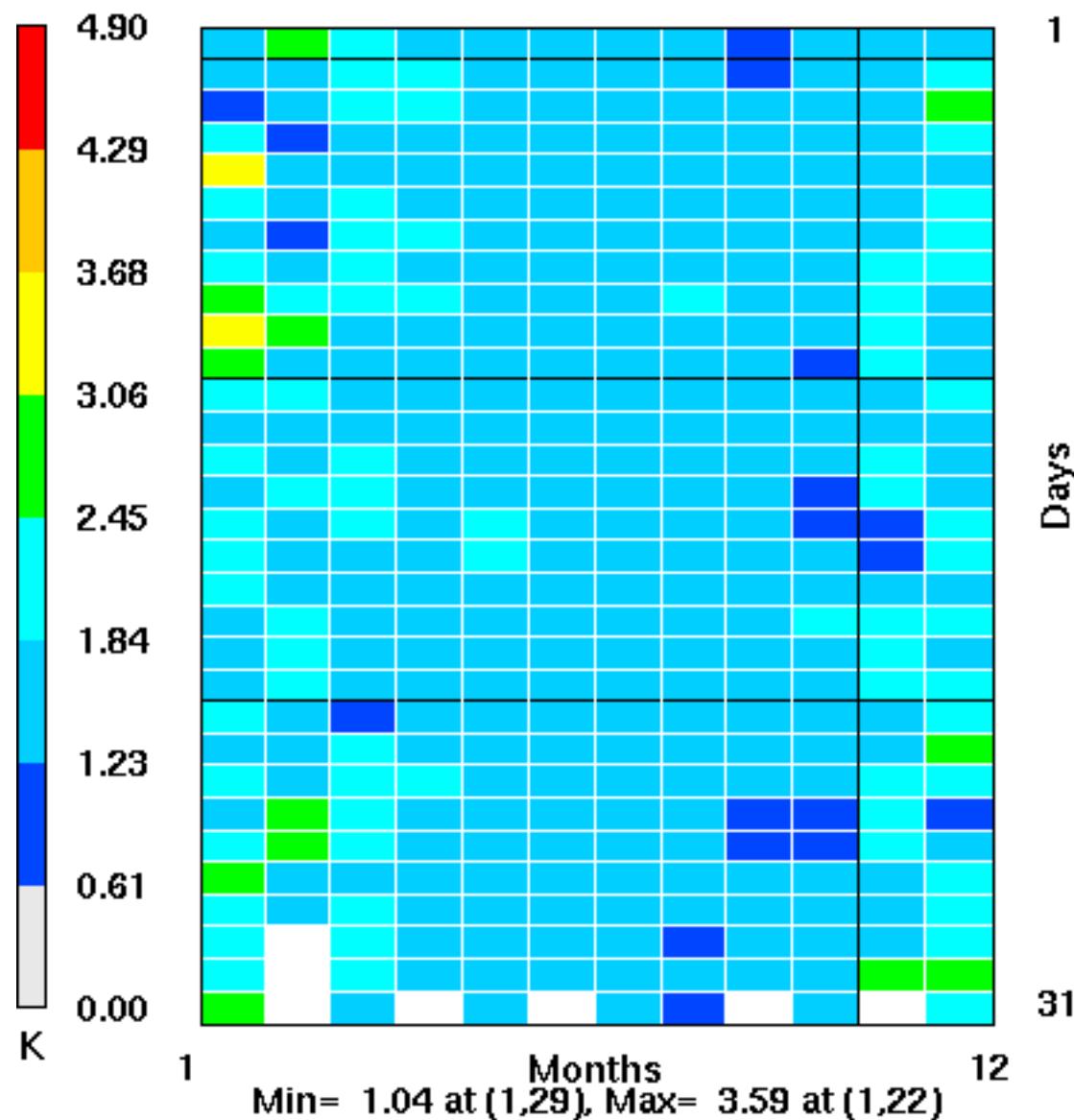
Temperature Bias

(2002, VISTAS: 12km, v02_aaa, 1.5m)



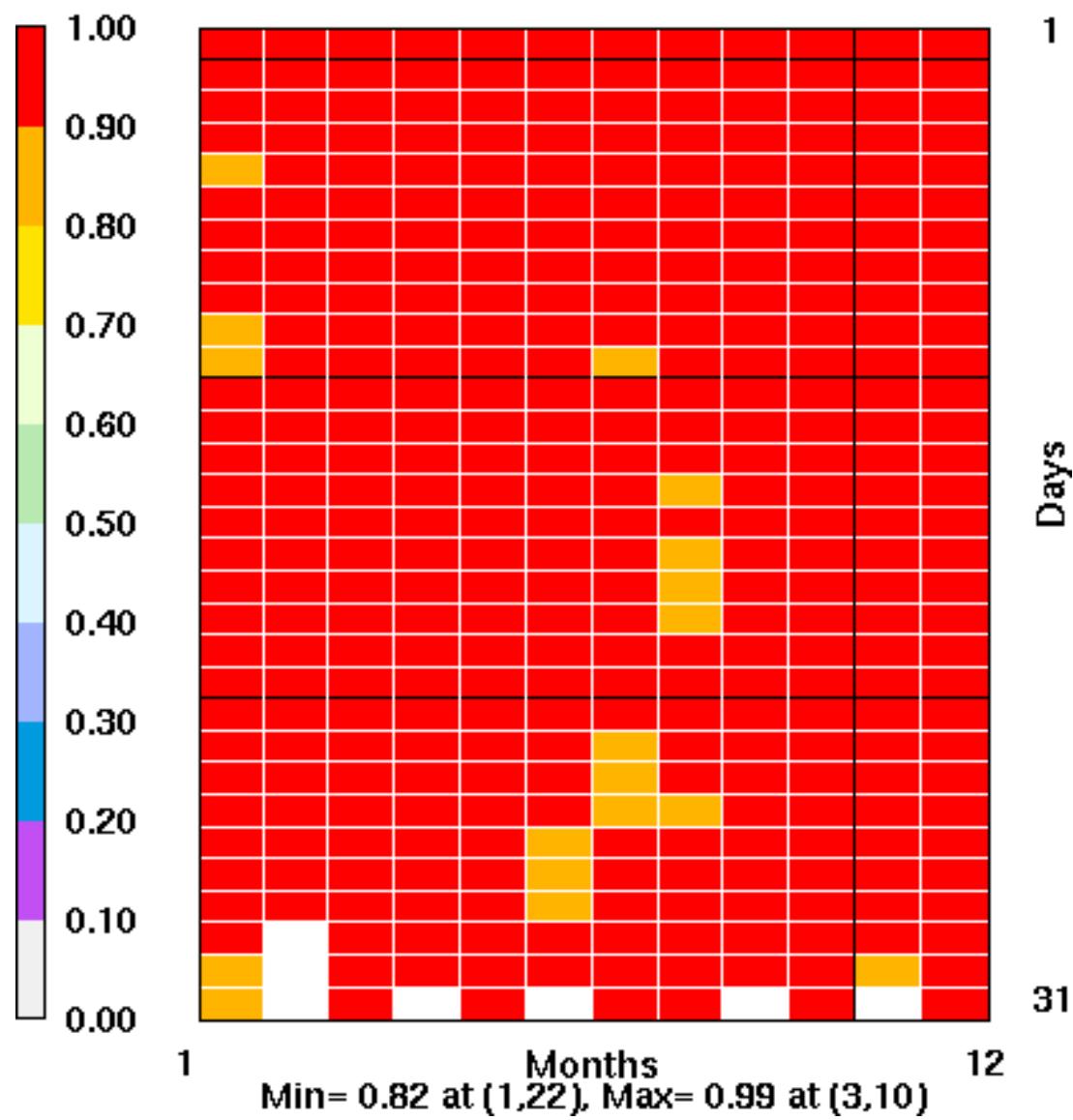
Temperature Error

(2002, VISTAS: 12km, v02_aaa, 1.5m)



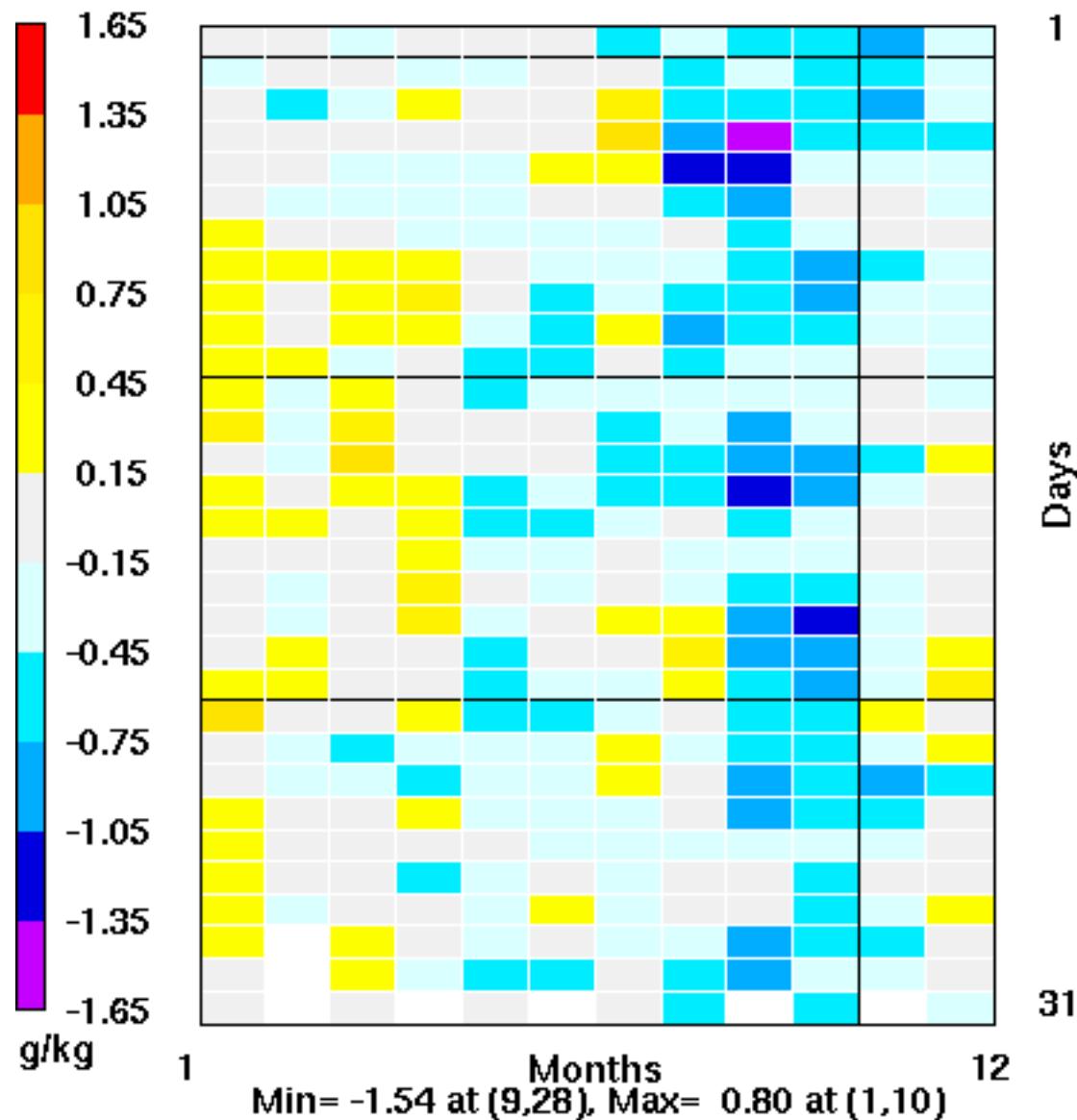
Temperature IA

(2002, VISTAS: 12km, v02_aaa, 1.5m)



Mixing Ratio Bias

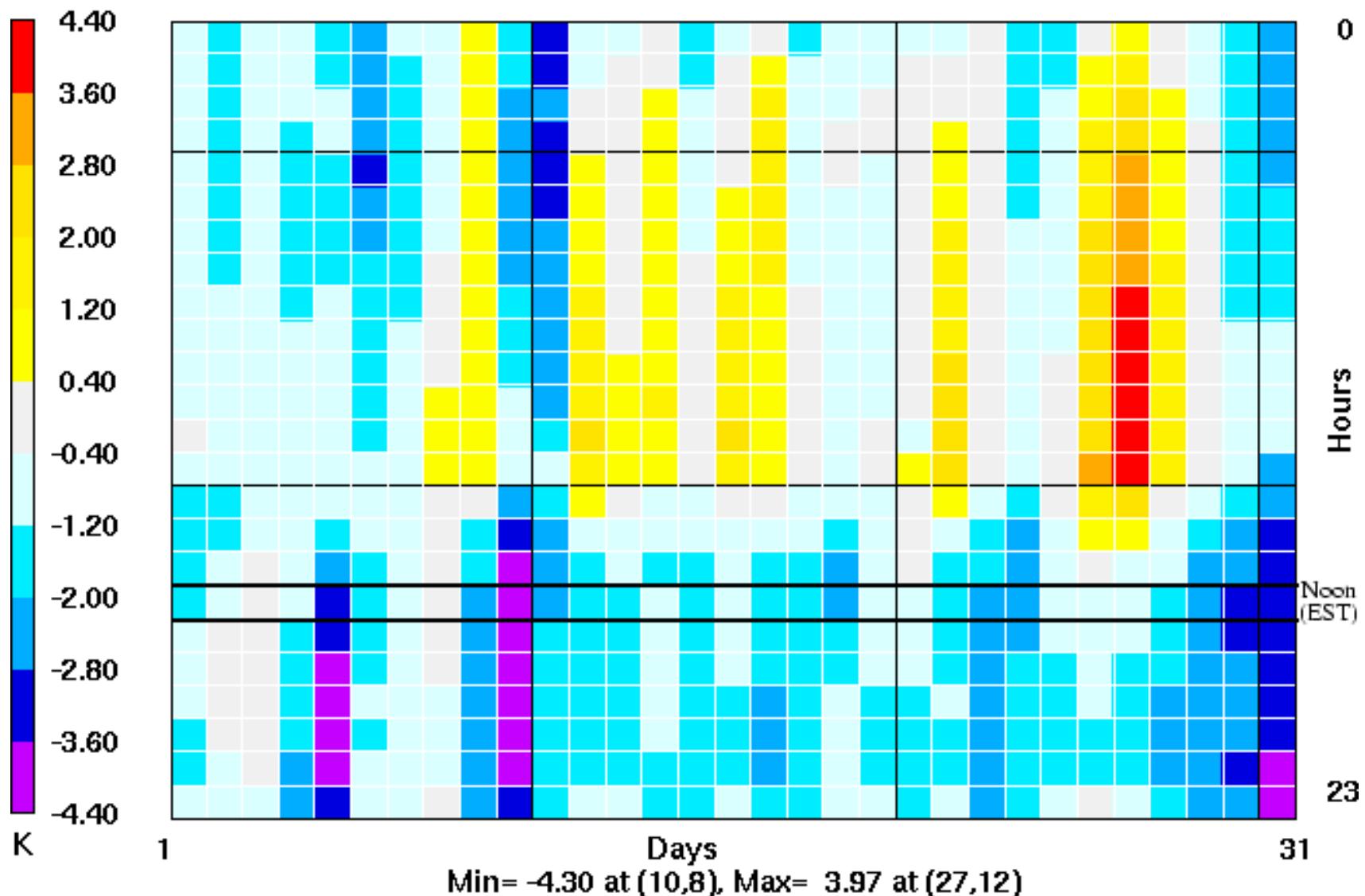
(2002, VISTAS: 12km, v02_aaa, Layer 1)



Monthly Bakergrams

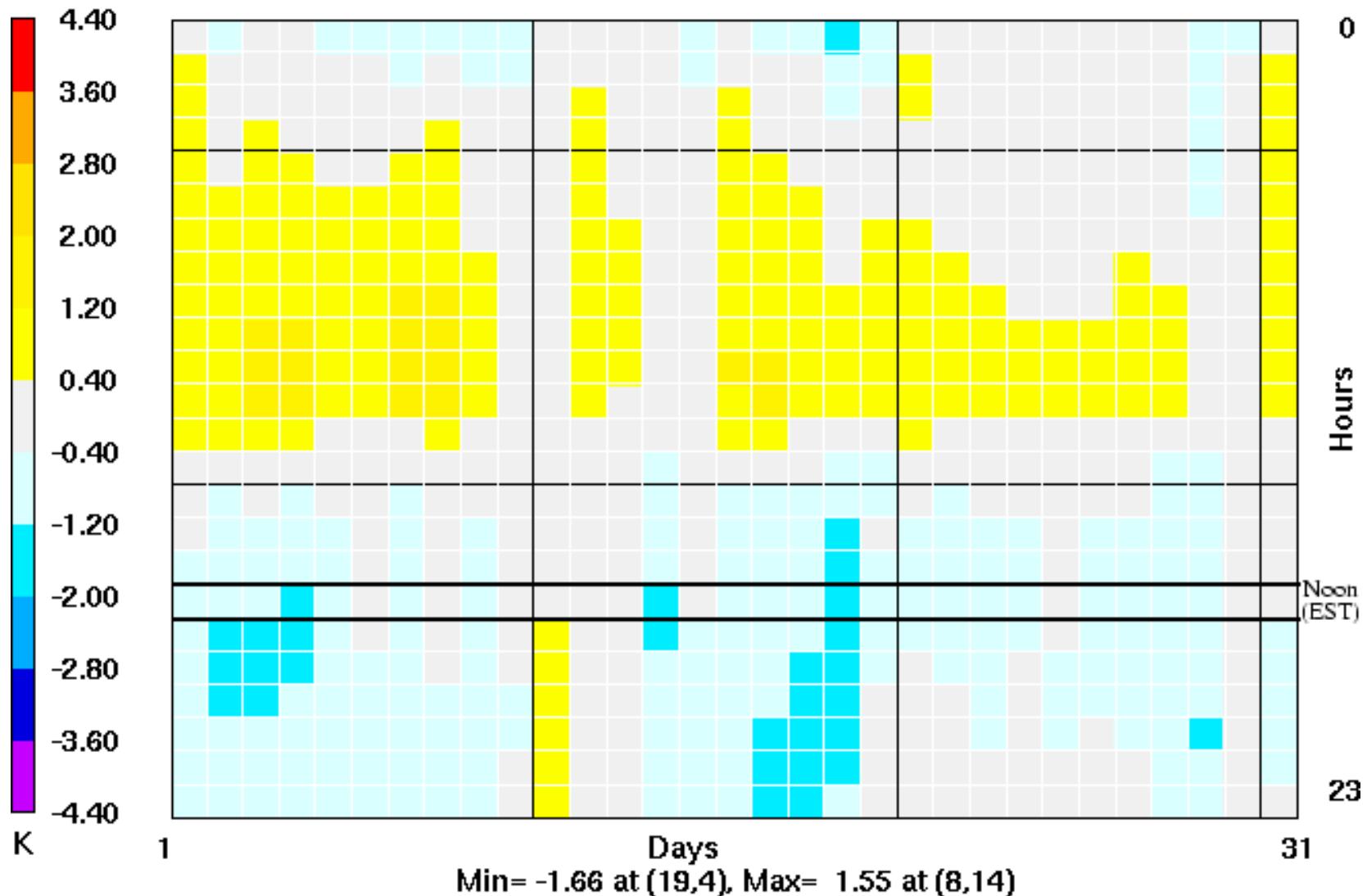
Temperature Bias

(jan02, VISTAS: 12km, v02_aaa, 1.5m)



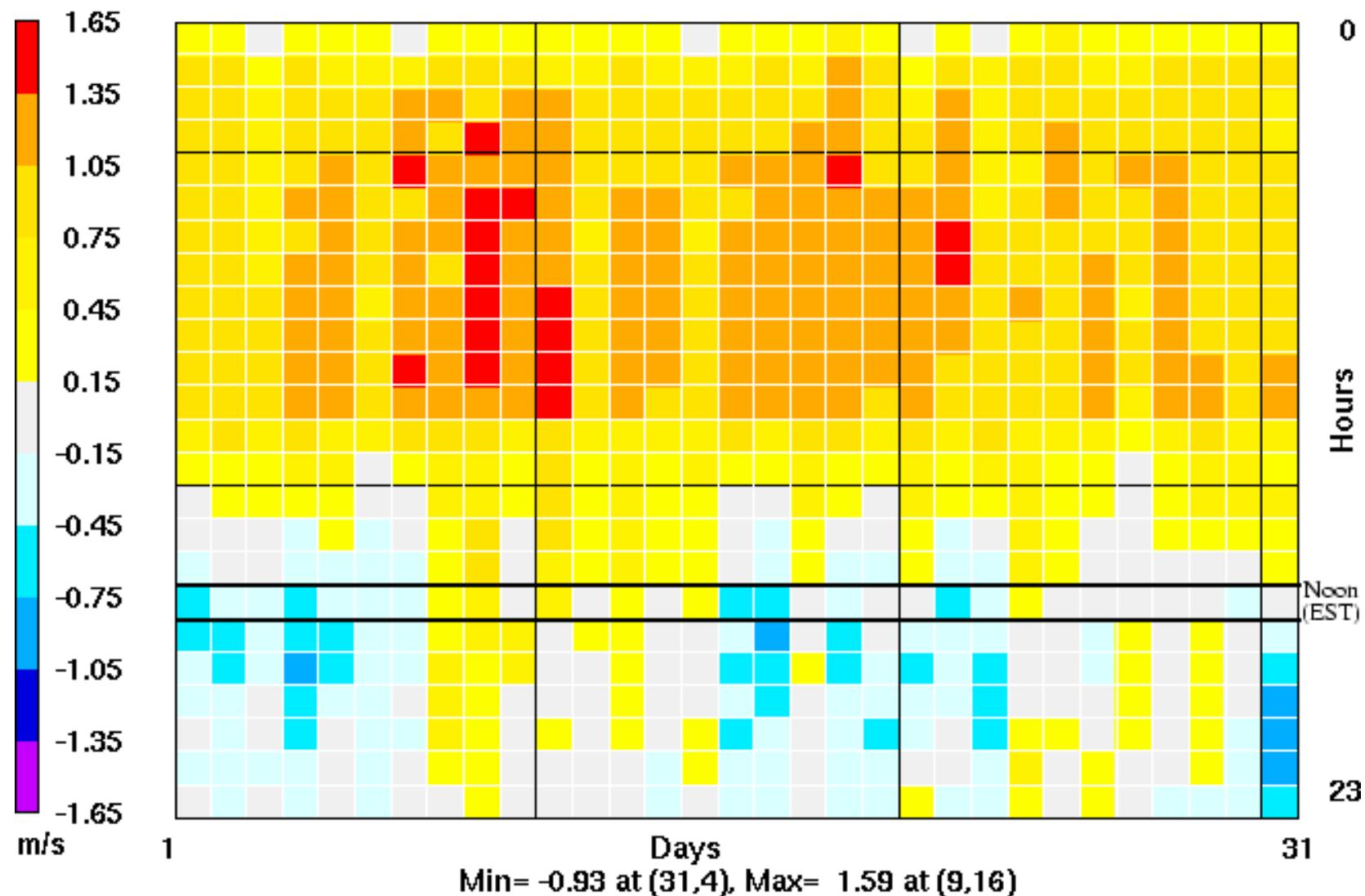
Temperature Bias

(jul02, VISTAS: 12km, v02_aaa, 1.5m)



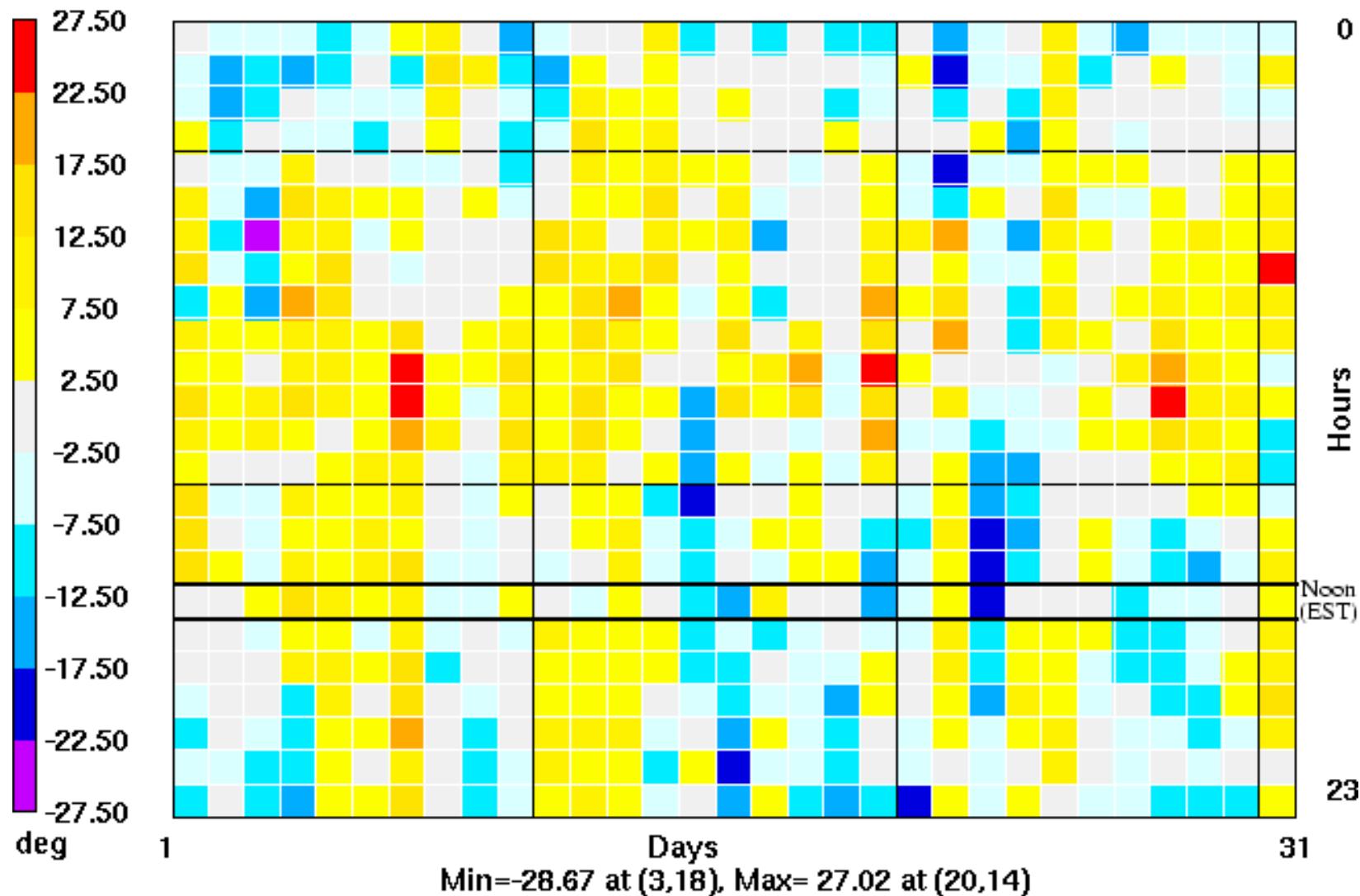
Wind Speed Bias

(jul02, VISTAS: 12km, v02_aaa, 10m)



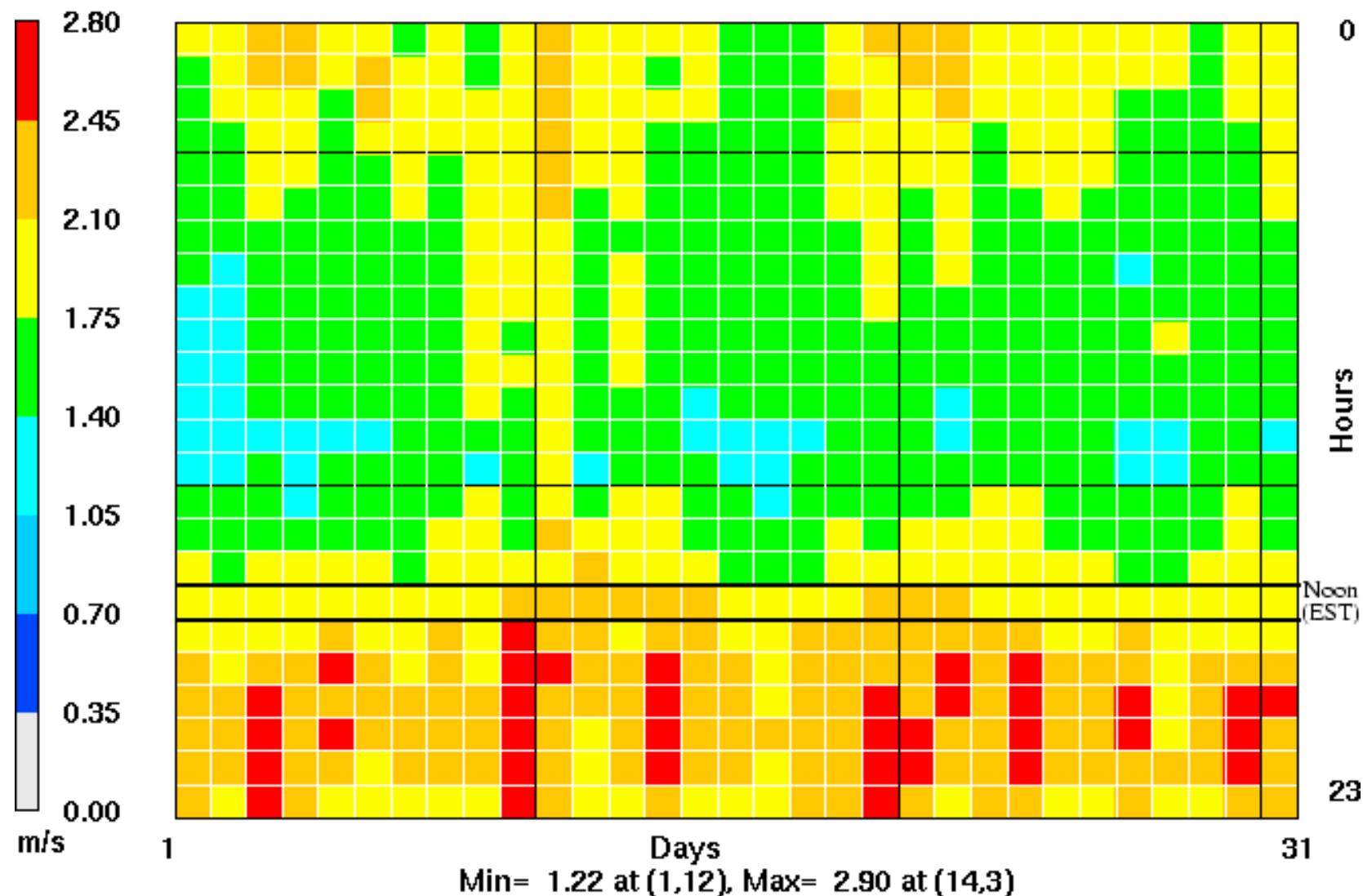
Wind Direction Bias

(jul02, VISTAS: 12km, v02_aaa, 10m)



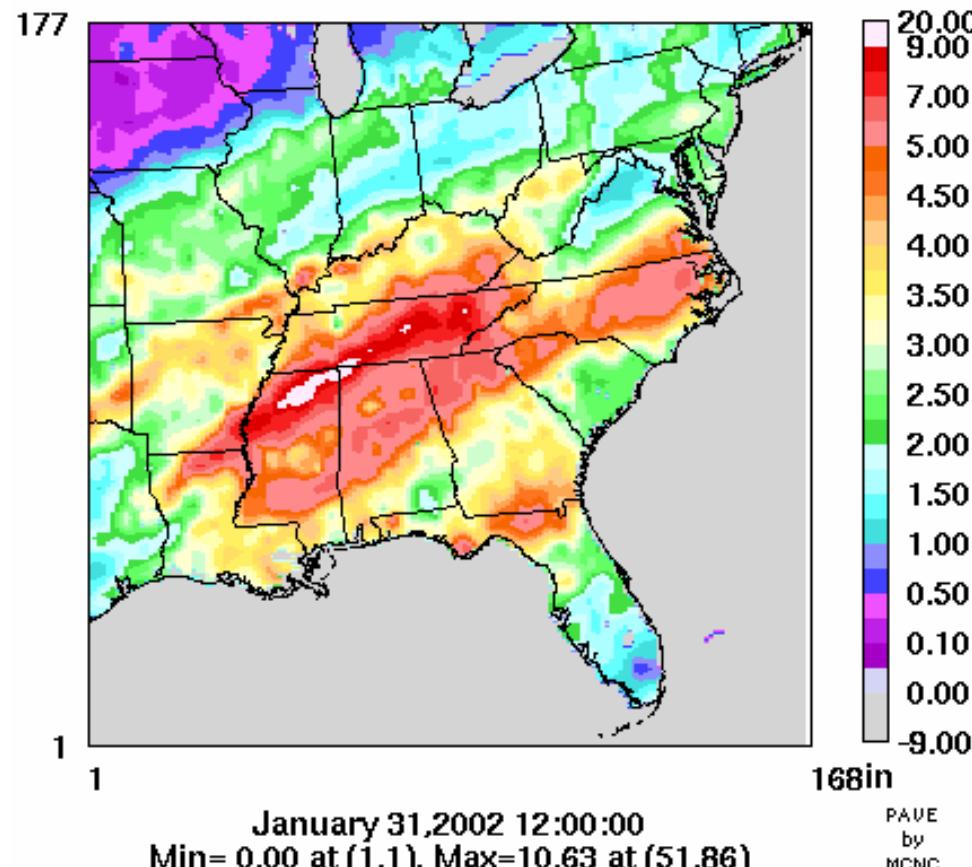
Magnitude of Error Vector

(jul02, VISTAS: 12km, v02_aaa, 10m)



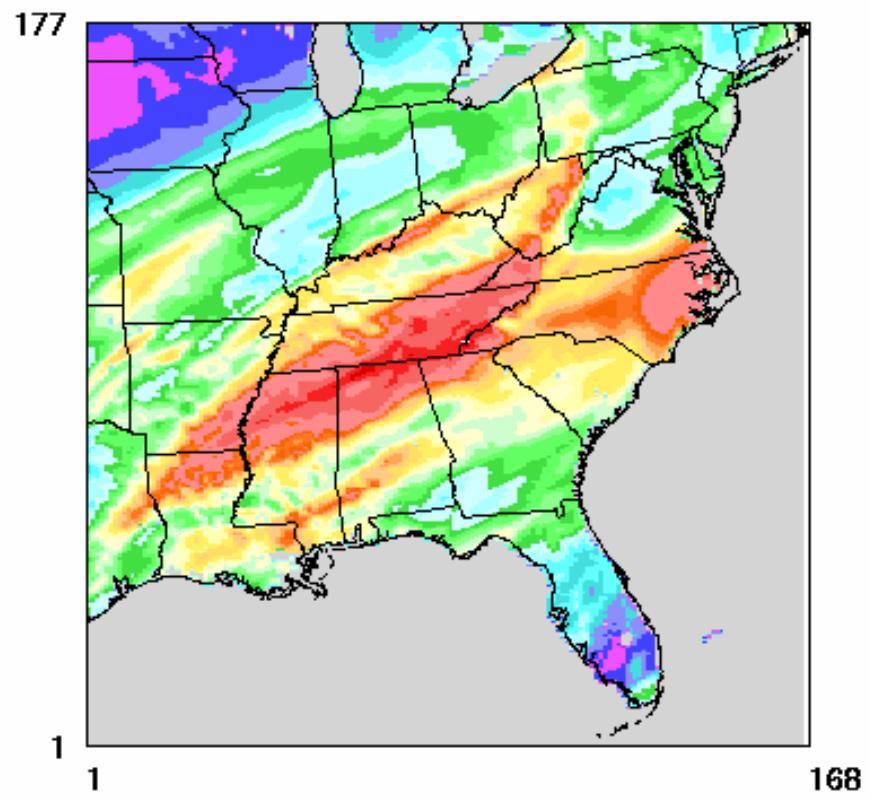
Monthly Total Precipitation (Obs)

(jan02, Full: 12km, v02_aaa)



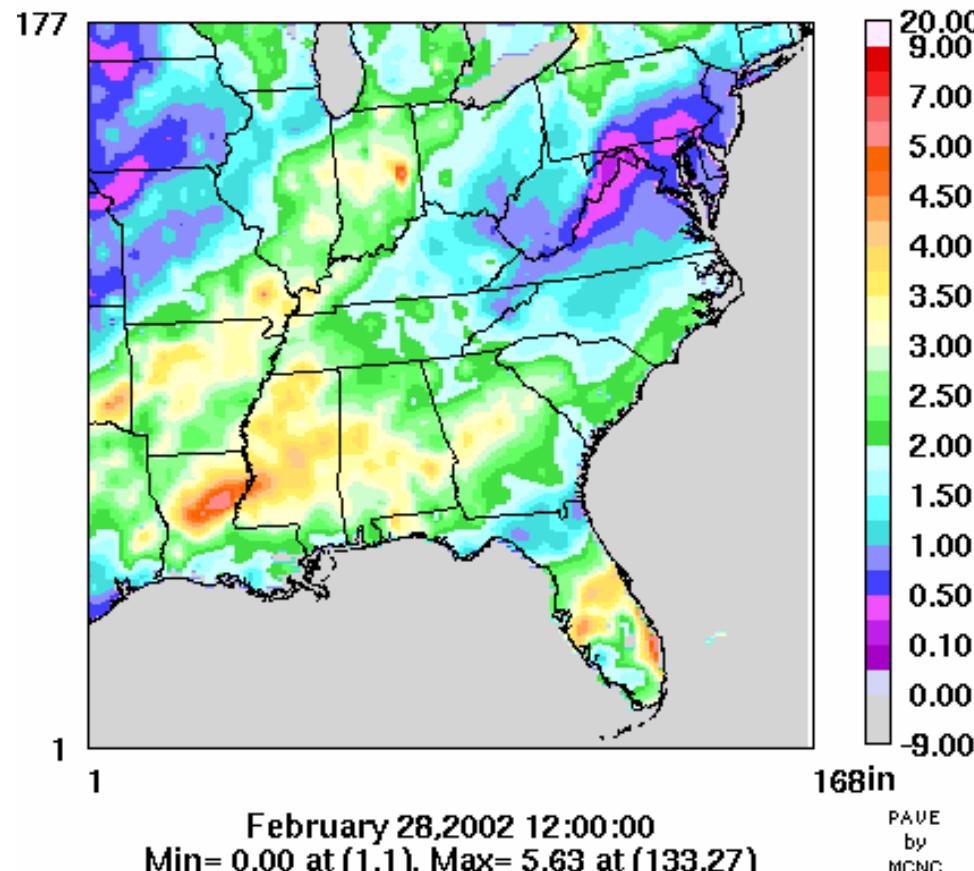
Monthly Total Precipitation (MM5)

(jan02, Full: 12km, v02_aaa)



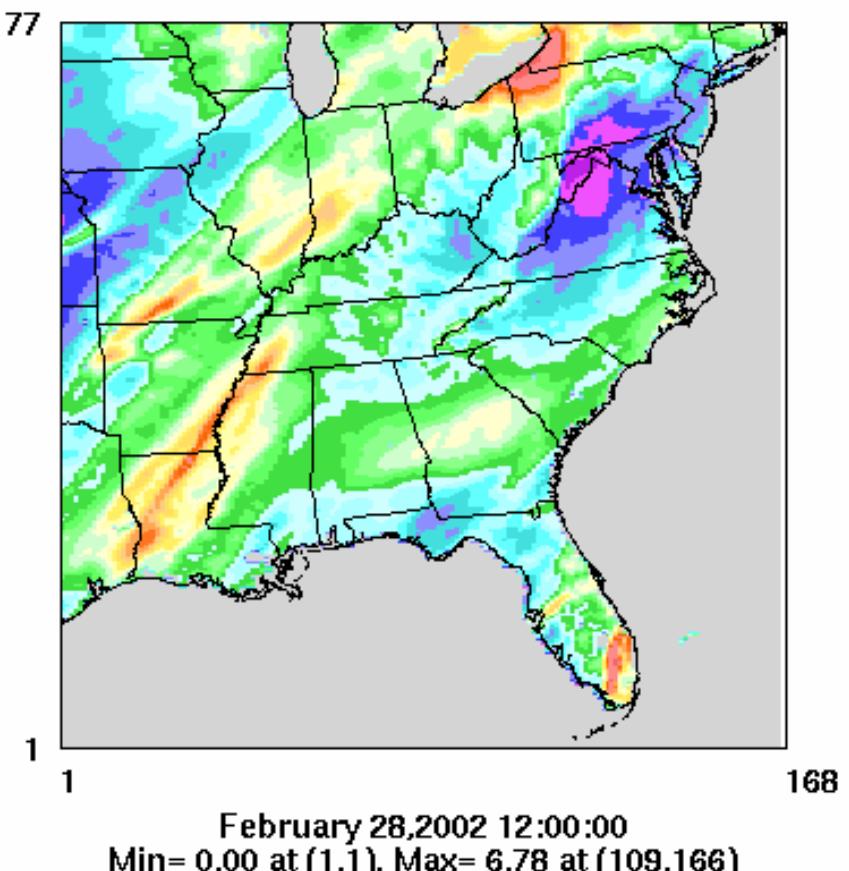
Monthly Total Precipitation (Obs)

(feb02, Full: 12km, v02_aaa)



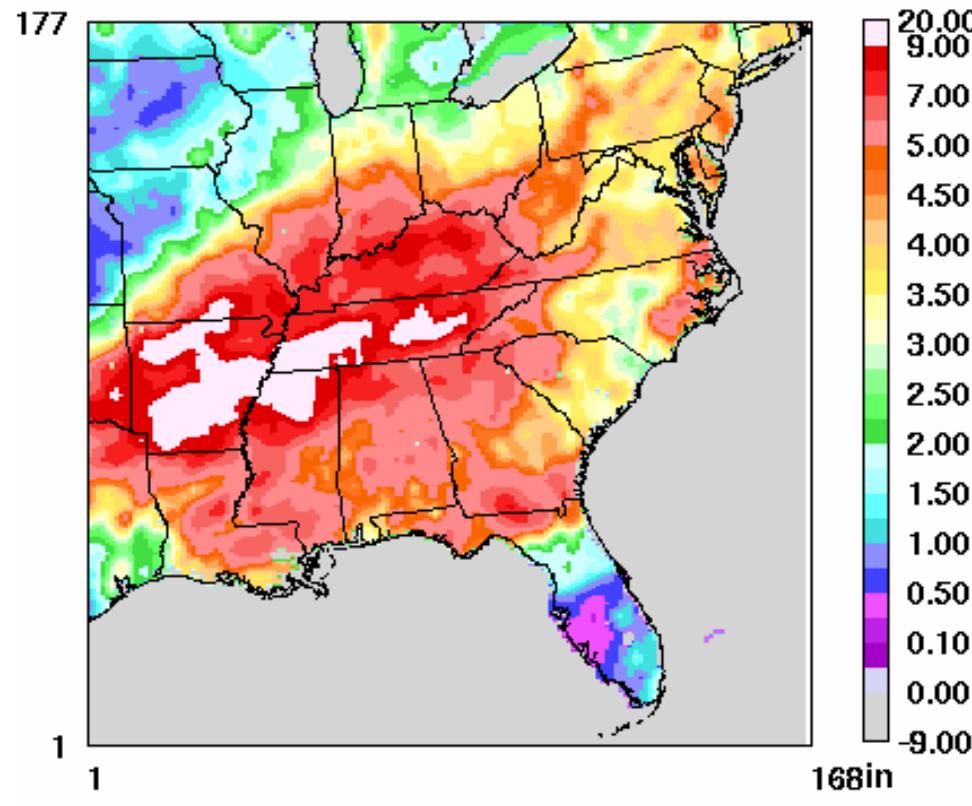
Monthly Total Precipitation (MM5)

(feb02, Full: 12km, v02_aaa)



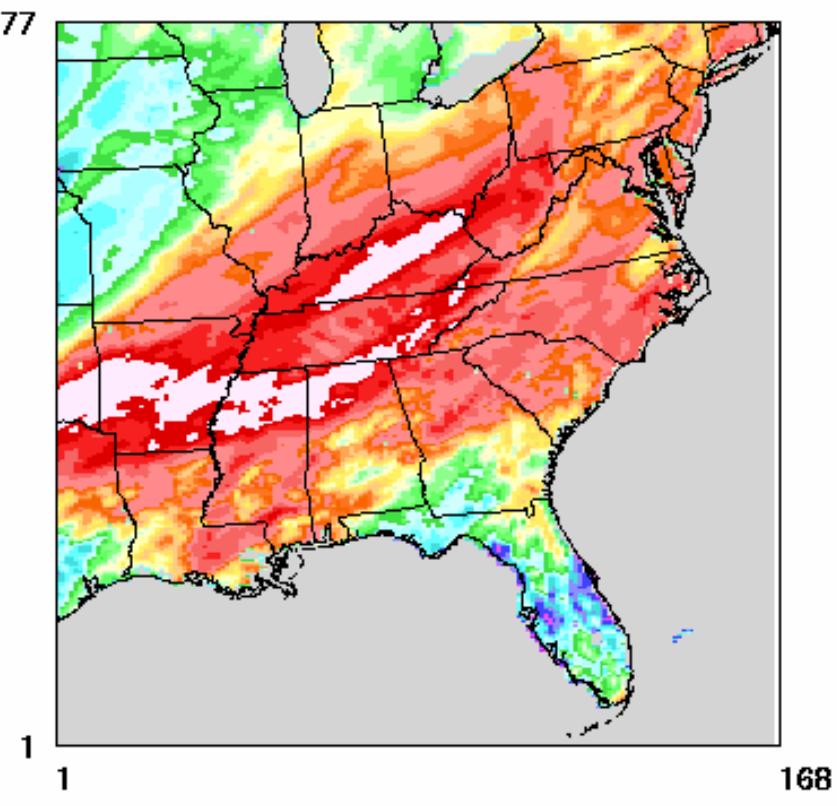
Monthly Total Precipitation (Obs)

(mar02, Full: 12km, v02_aaa)



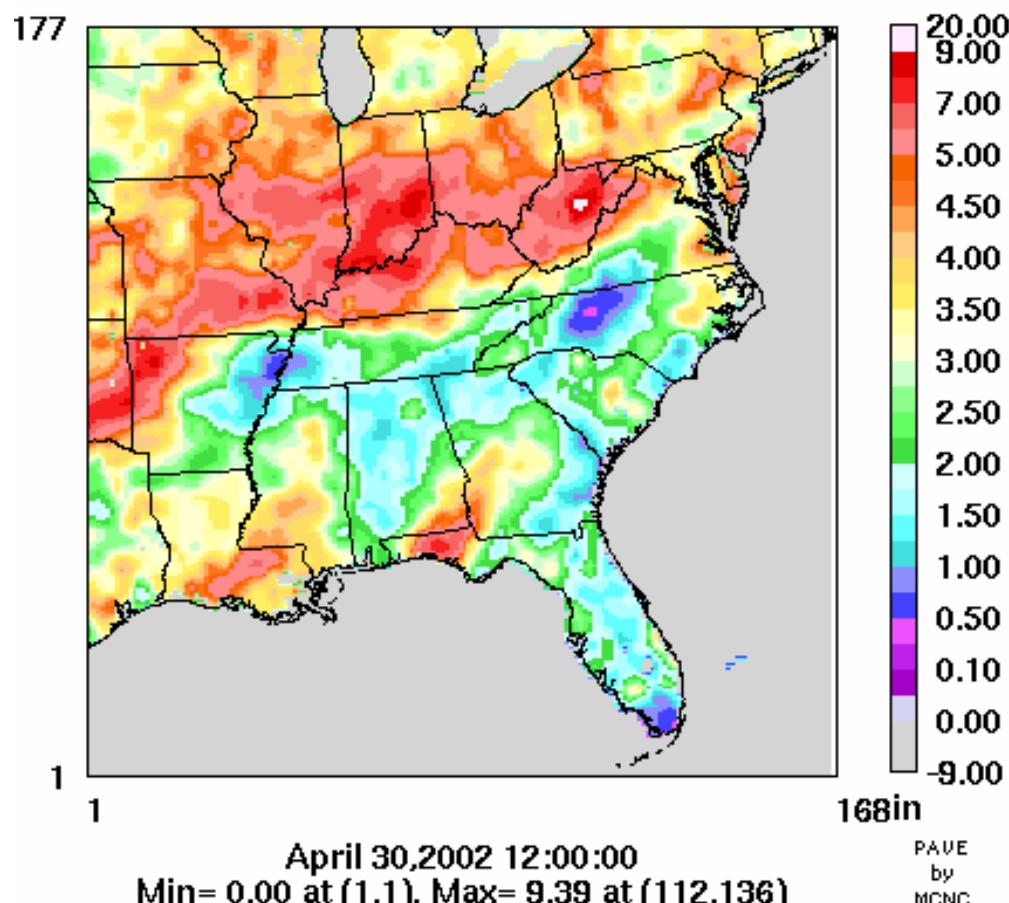
Monthly Total Precipitation (MM5)

(mar02, Full: 12km, v02_aaa)



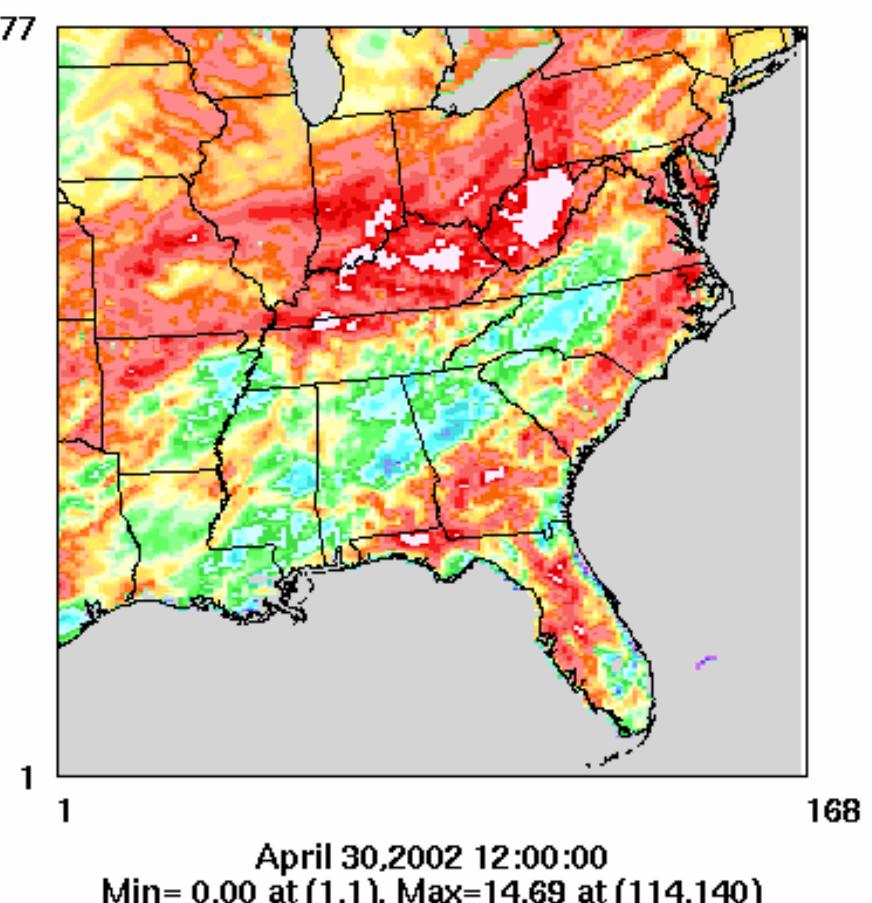
Monthly Total Precipitation (Obs)

(apr02, Full: 12km, v02_aaa)



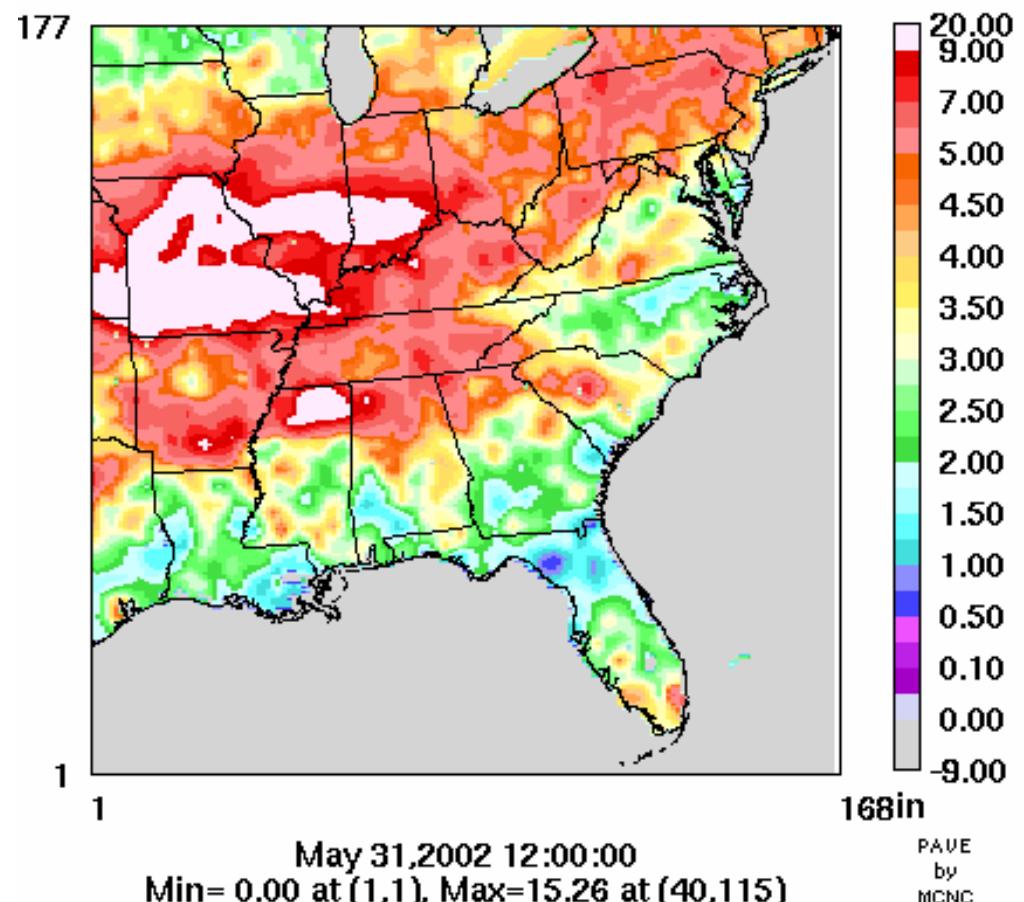
Monthly Total Precipitation (MM5)

(apr02, Full: 12km, v02_aaa)



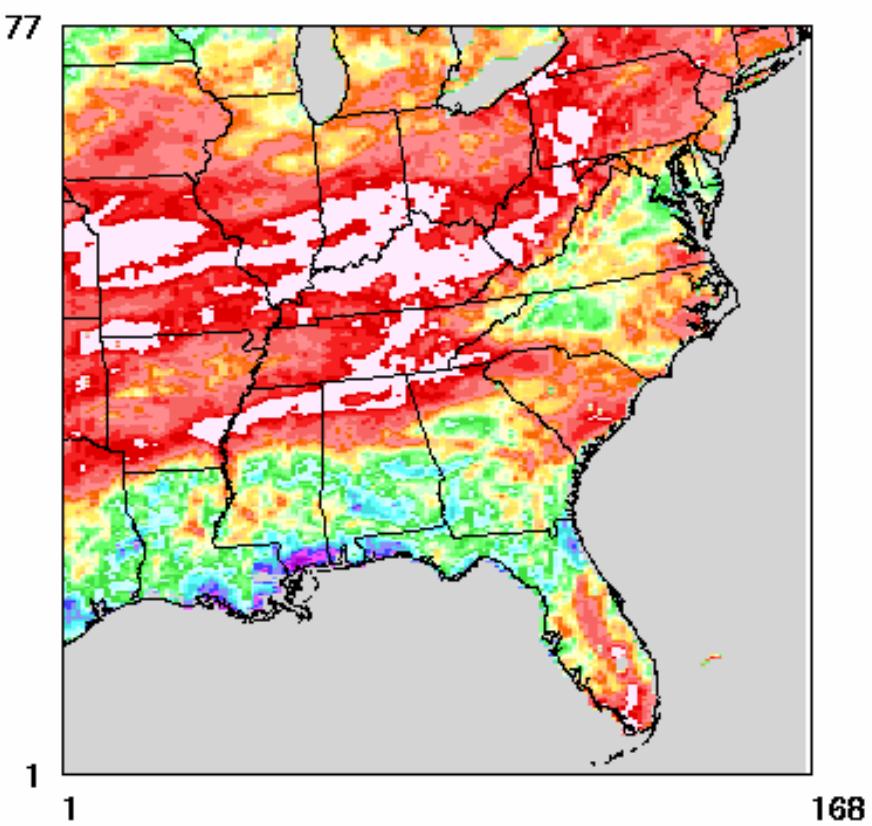
Monthly Total Precipitation (Obs)

(may02, Full: 12km, v02_aaa)



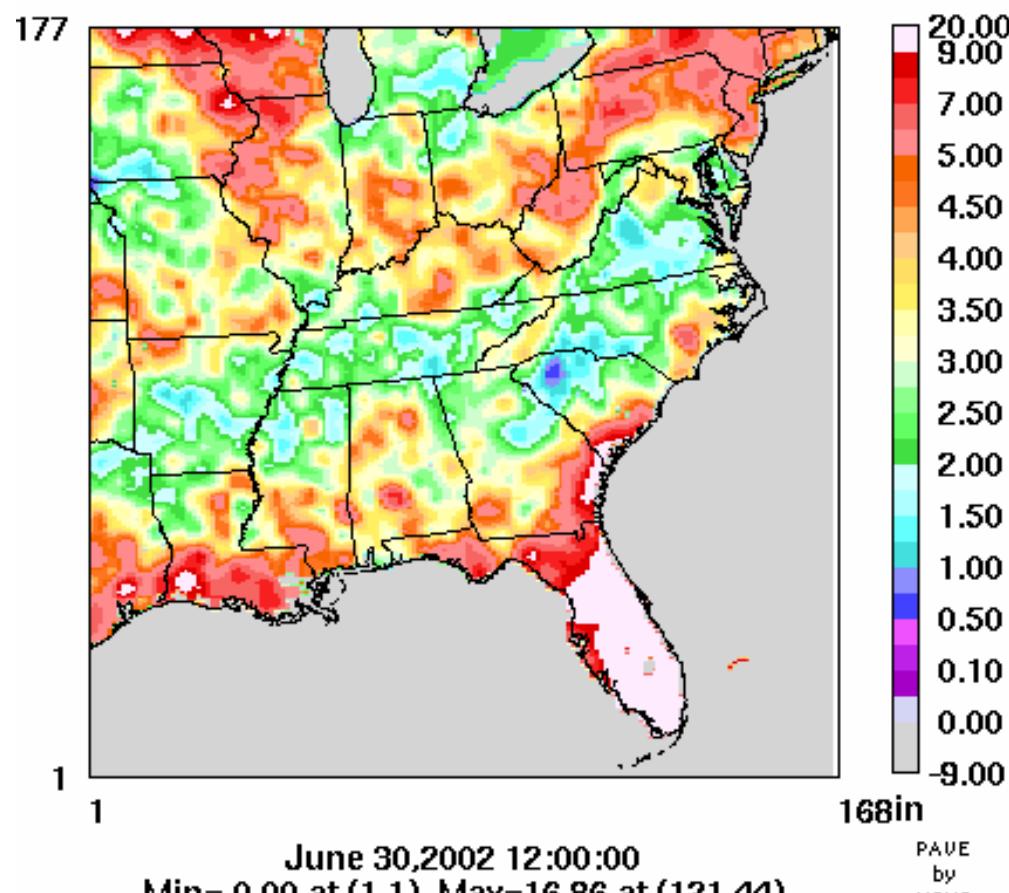
Monthly Total Precipitation (MM5)

(may02, Full: 12km, v02_aaa)



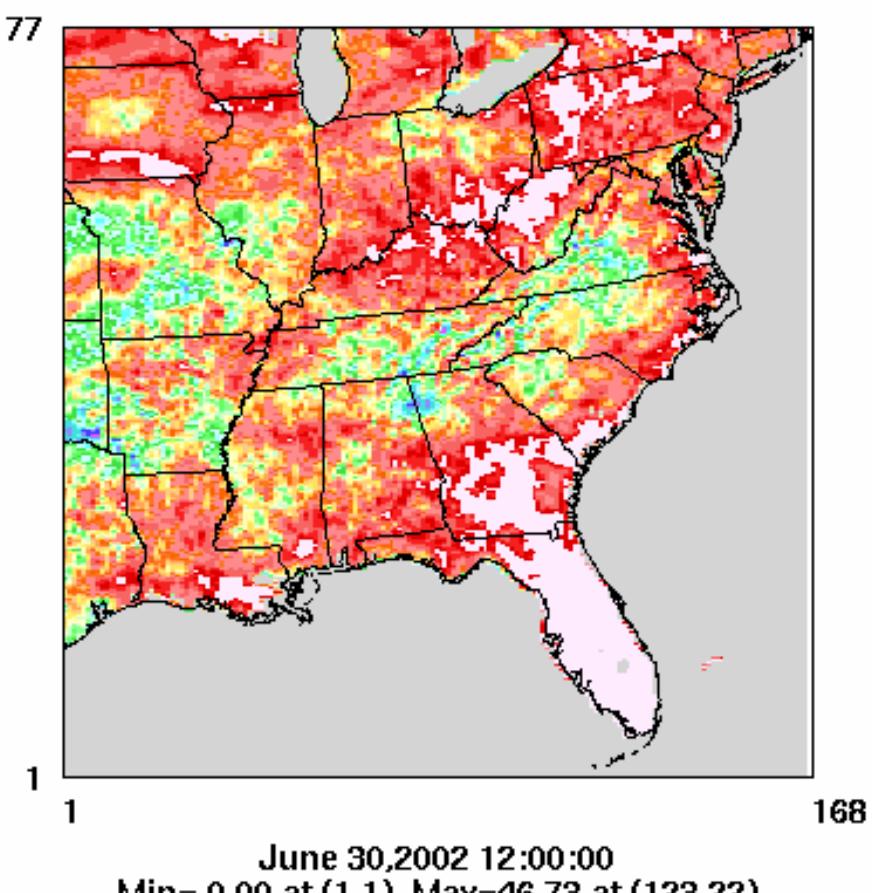
Monthly Total Precipitation (Obs)

(jun02, Full: 12km, v02_aaa)



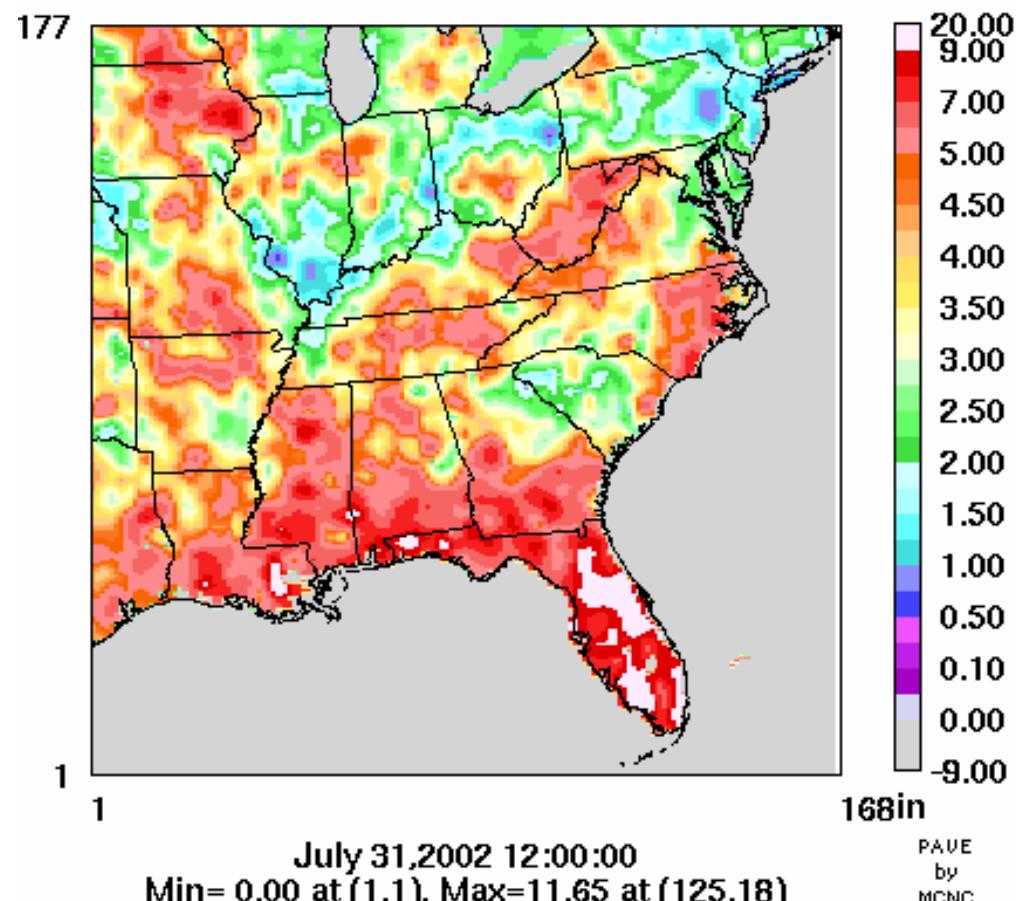
Monthly Total Precipitation (MM5)

(jun02, Full: 12km, v02_aaa)



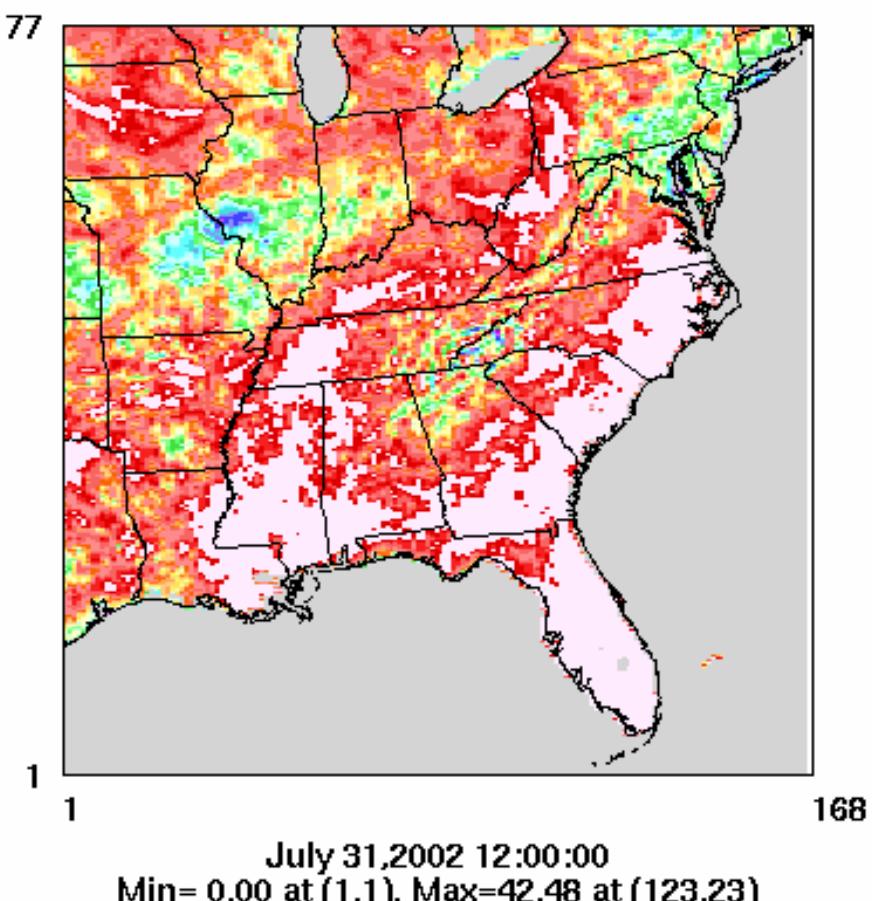
Monthly Total Precipitation (Obs)

(jul02, Full: 12km, v02_aaa)

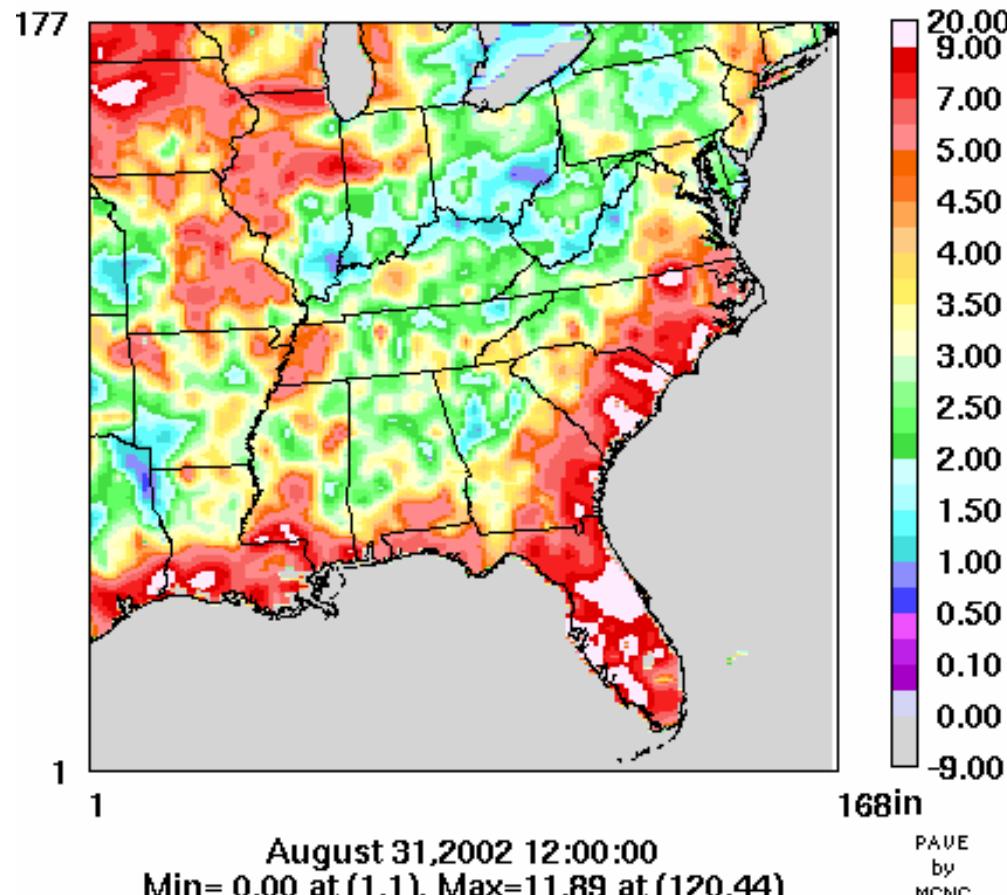


Monthly Total Precipitation (MM5)

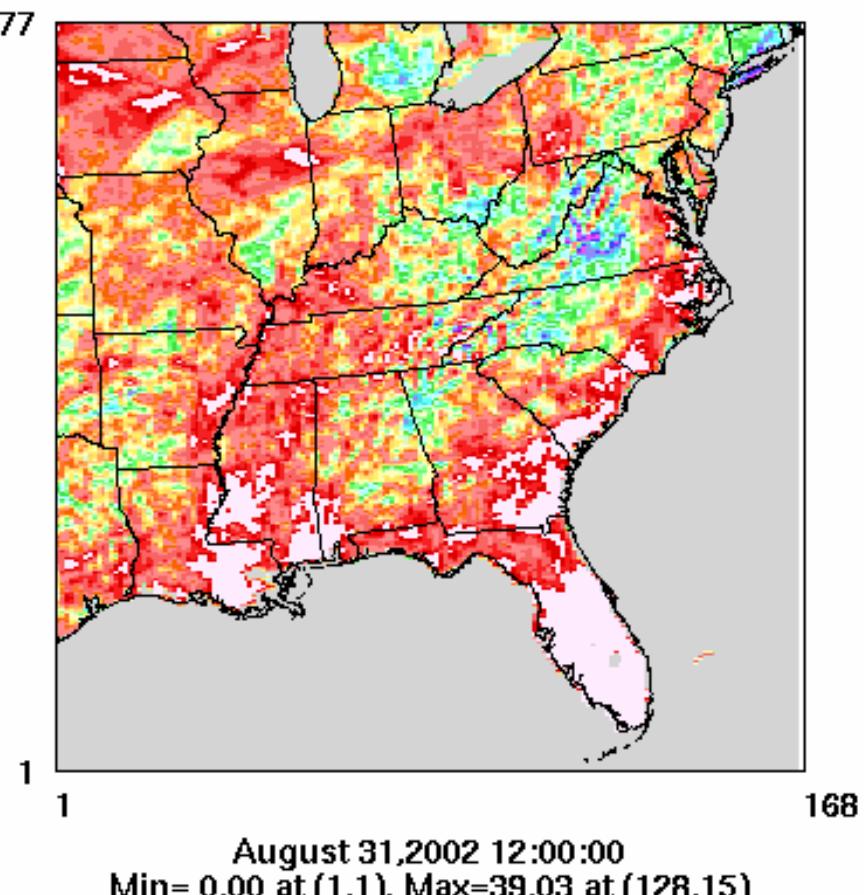
(jul02, Full: 12km, v02_aaa)



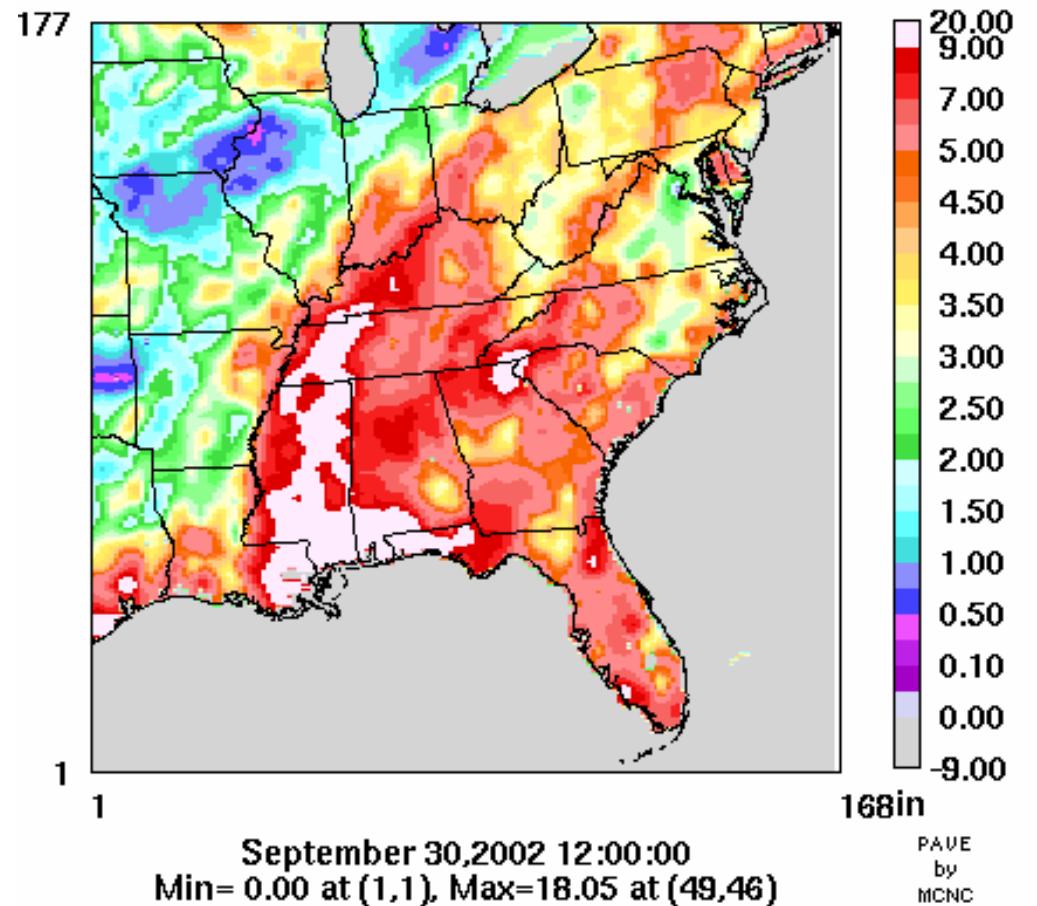
Monthly Total Precipitation (Obs)
(aug02, Full: 12km, v02_aaa)



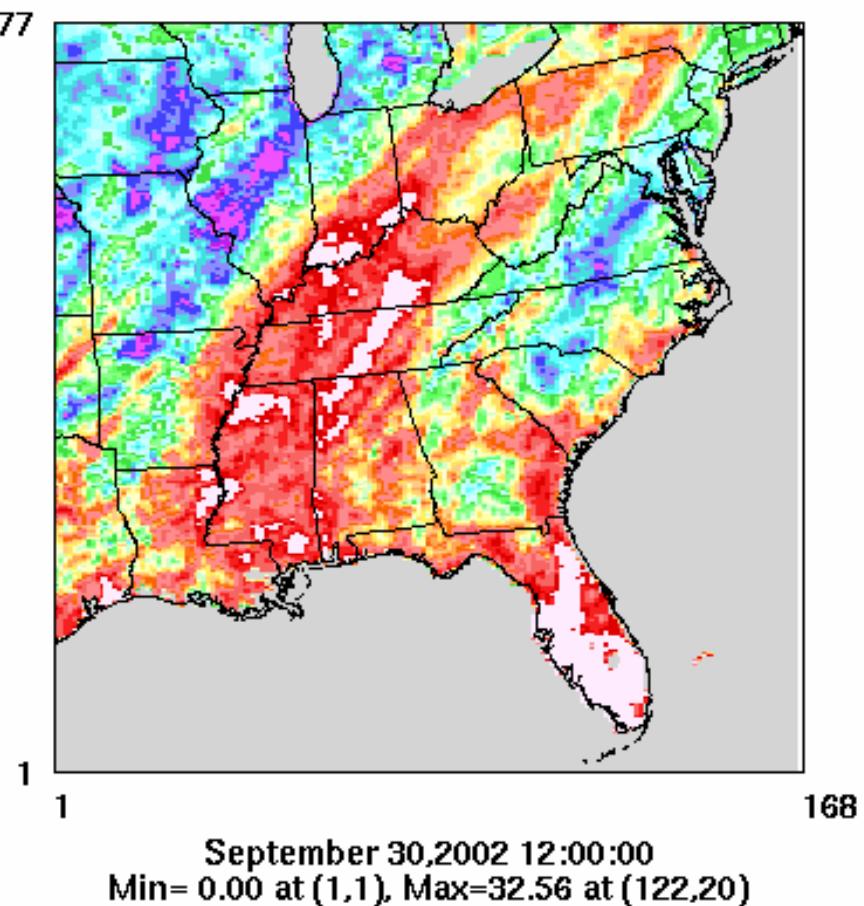
Monthly Total Precipitation (MM5)
(aug02, Full: 12km, v02_aaa)



Monthly Total Precipitation (Obs)
(sep02, Full: 12km, v02_aaa)

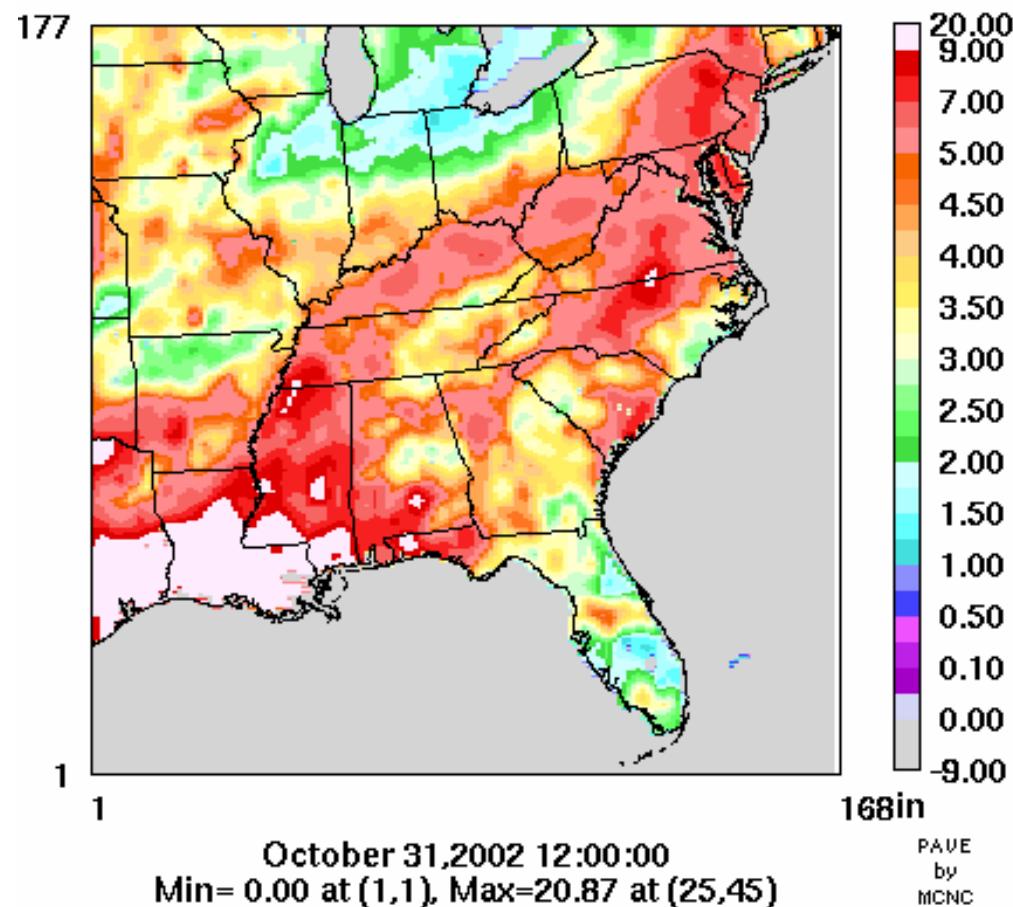


Monthly Total Precipitation (MM5)
(sep02, Full: 12km, v02_aaa)



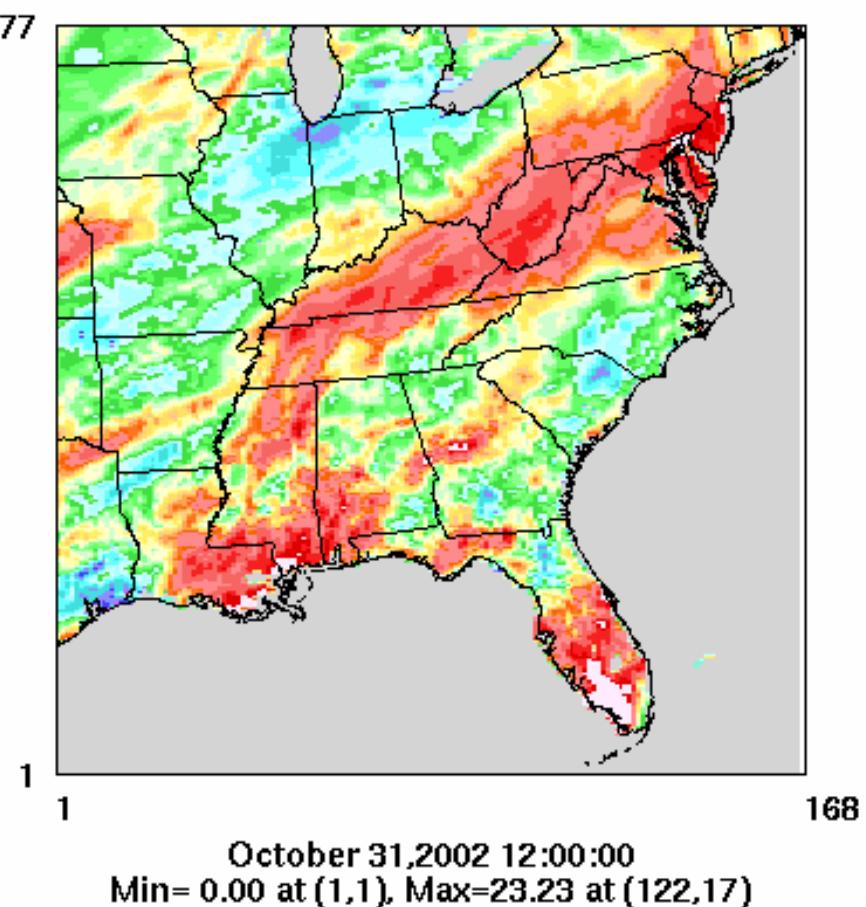
Monthly Total Precipitation (Obs)

(oct02, Full: 12km, v02_aaa)



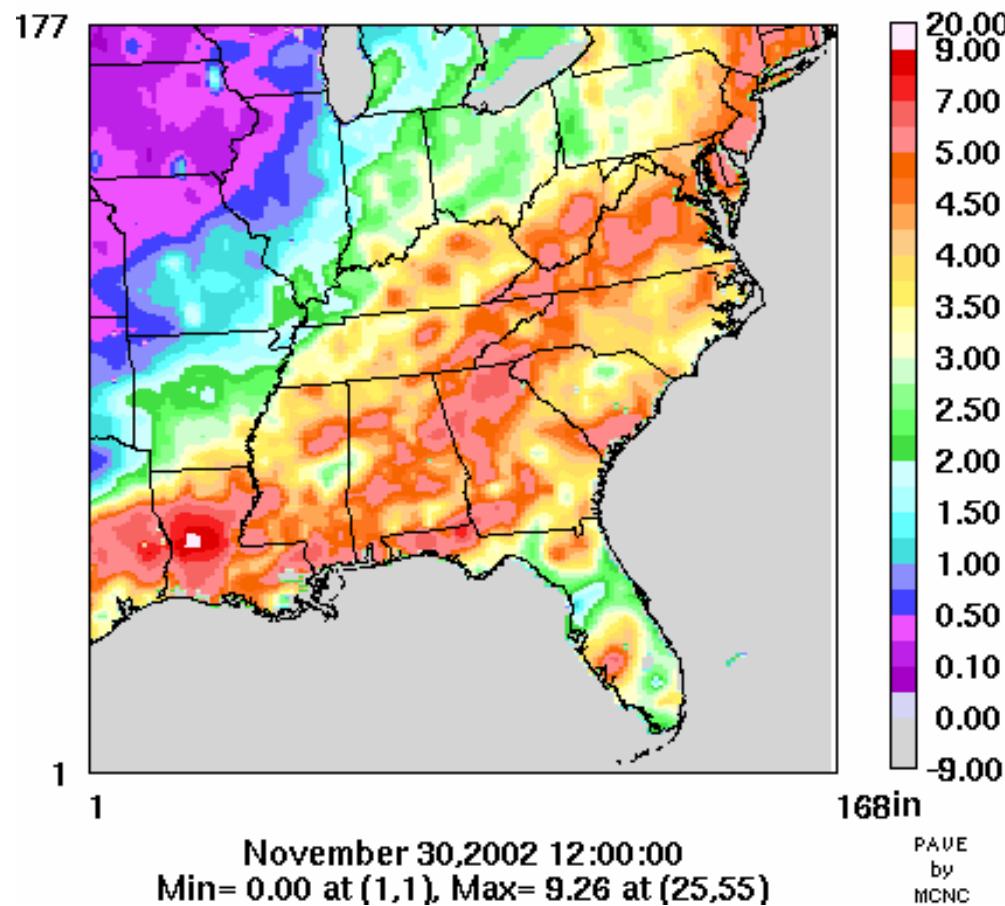
Monthly Total Precipitation (MM5)

(oct02, Full: 12km, v02_aaa)



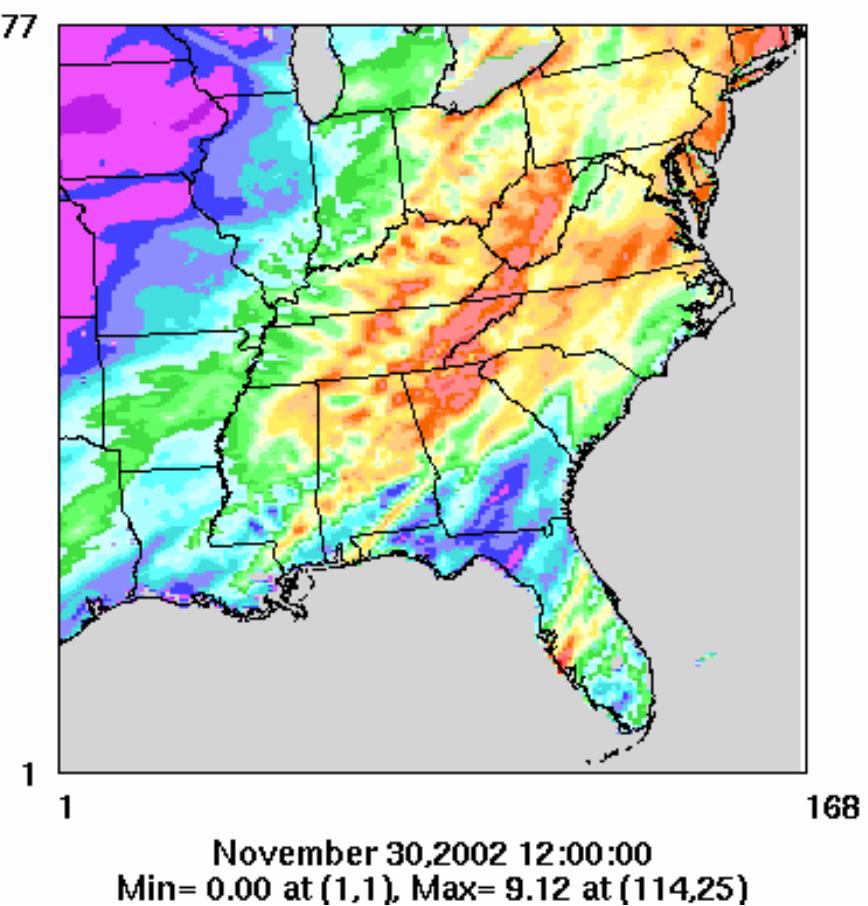
Monthly Total Precipitation (Obs)

(nov02, Full: 12km, v02_aaa)



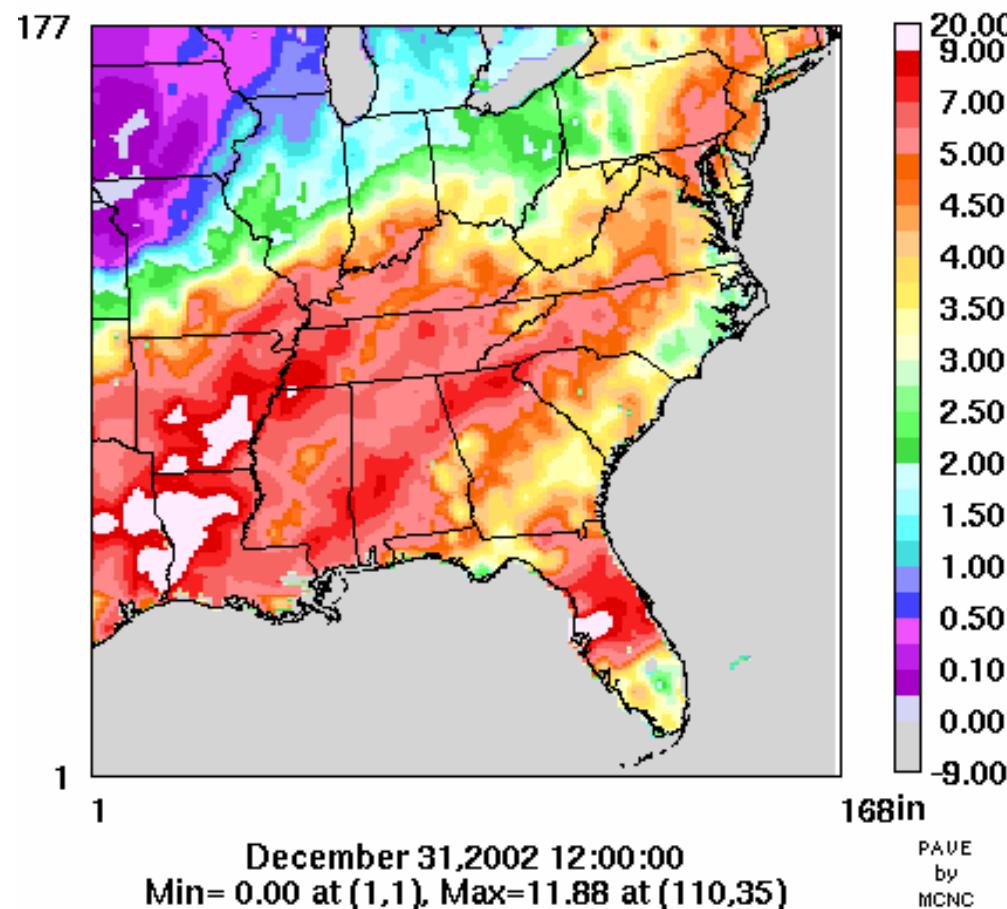
Monthly Total Precipitation (MM5)

(nov02, Full: 12km, v02_aaa)



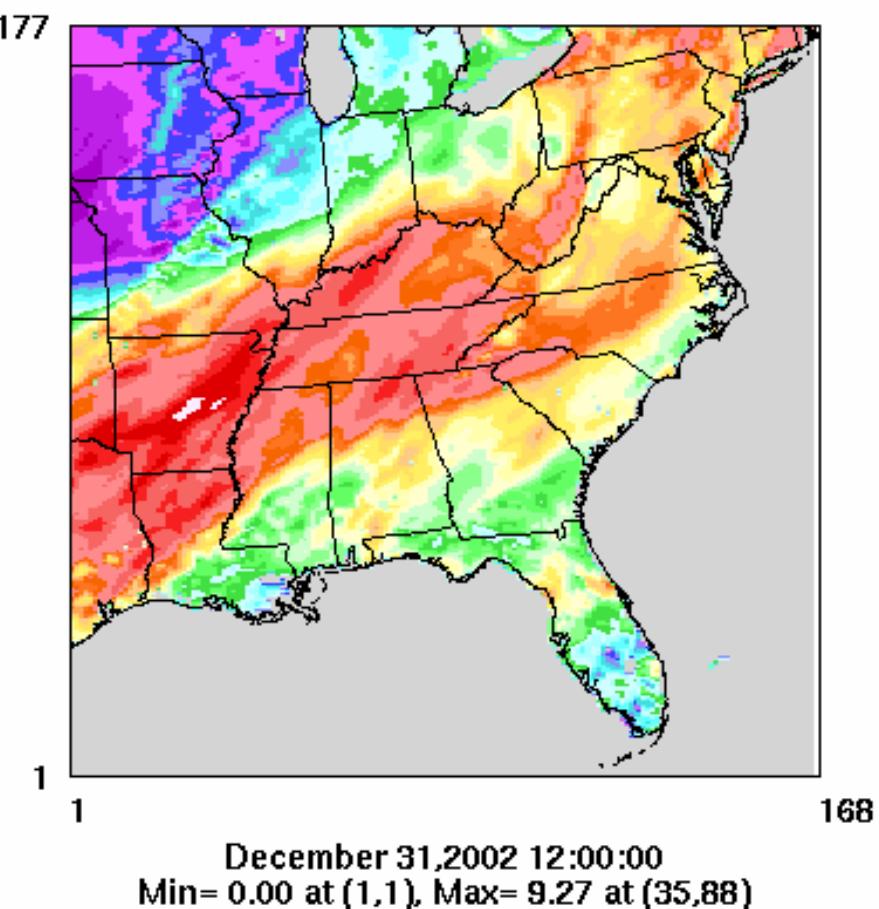
Monthly Total Precipitation (Obs)

(dec02, Full: 12km, v02_aaa)



Monthly Total Precipitation (MM5)

(dec02, Full: 12km, v02_aaa)



Statistical Observations

- ◆ Most stats fall within “benchmarks”
 - VISTAS region modeled reasonably well
- ◆ Wintertime cold bias
 - Expected from sensitivity results
 - “Benchmarks” stem primarily from non-winter cases
- ◆ Winds
 - Positive speed bias in VISTAS region
 - ◆ “Calms” included in obs set
 - WRAP winds poorest statistically
 - ◆ Dir errors ~40 deg; low speed bias
 - ◆ 36-km grid too large to resolve mountain/sea breezes
 - ◆ Analysis nudging problematic at this scale/region

Performance Summary

- ◆ Modeling Results Are Generally as Expected
- ◆ Precipitation Amounts Overdone in Summer
 - Problem especially acute in southeast
 - Precipitation generally unbiased at 0.01 and 0.05 in thresholds
 - ◆ Issue isn't so much that it rains when it shouldn't, but rather that when it rains it (over)pours
 - ◆ Convective component of MM5 rain almost certainly to blame
 - ◆ It's possible that the CPC analyses "miss" much of the true precip due to the convective nature of the obs
- ◆ Cold Bias in Winter
 - Soil initialization procedure needs improvement (beyond scope of project)
 - 10-day soil time scale too long?

Performance Summary (continued)

- ◆ Other than winter cold bias, temps generally well-modeled
 - Slightly dampened diurnal range
- ◆ Mixing ratios/RH generally well-modeled
 - Noticeable dry bias in autumn
 - Bias mainly a daytime issue
 - ◆ Too much mixing?
- ◆ Clouds generally unbiased
 - Nighttime positive bias seen in summer

Performance Summary (continued)

- ◆ Wind speed (apparent) performance depends on treatment of calm observations
 - Issue especially important in southeast
 - ◆ Treating calms as speed=0 suggests a high speed bias for all seasons, worsening in summer/fall, 12km more biased than 36km, bias generally a nighttime issue
 - ◆ Ignoring calms yields much better results, with 12km generally non-biased and 36km slightly low biased
 - ◆ Treating calms as 1.5 kts (halfway between 0 and instrument threshold) is probably best, suggesting a high bias at 12km, but within "benchmarks"